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METALLIC SPOOLS FOR FIELD COILS

Aside from the better mechanical support which a metallic field spool affords the coil wound upon it, there is an important electrical advantage which may to a certain extent be obtained, but one which, however, is partially offset by a magnetic disadvantage. The metallic spool forms a closed secondary which, in case the field circuit is broken, prevents an abnormal rise of voltage and a tendency to impair the insulation of the winding. This secondary action, however, makes that of the field magnet slower and prevents it from responding to frequent and excessive changes in load, a condition which is very desirable but incompatible with the former. Quickness of action is sought by laminating the pole-pieces, while a slow action is to some extent restored by surrounding them with iron sheaths. Laminated pole-pieces are of unquestioned value in this respect and the alacrity with which they allow of rapid fluctuations in the magnetic induction should not be counteracted too strongly by the use of heavy metallic spools. The electrical conductivity of the latter therefore becomes a matter worthy of serious consideration. It should be large enough to allow of only comparatively small currents to flow resulting from sudden and excessive changes of magnetism, which will be sufficient to protect the winding at such times. The latest type of field spool is made of riveted sheet iron and the heads are of cast brass provided with many perforations. While thus obtaining economy in material and ease of construction, it is probable that some designers have so increased the electrical resistance of their field spools as to secure an important advantage of which they were not aware. Where laminated pole-pieces are not used of course these considerations do not enter.

SPEED OF ELECTRIC CARS.

The question of speeds of electric cars is treated in an article by Mr. Baxter, which appears in other columns of this issue. Since the introduction of the electric railway the tendency has been toward a gradually increased speed, necessitating an increased motor output. This tendency, with a few exceptions, has resulted in the almost universal adoption of comparatively large motors, generally two of 25 horse-power each, placed on cars of various sizes running at various speeds under widely differing conditions of traffic. It is obvious that the conditions which obtain in large cities are not found in the smaller towns and in cross-country practice. The city requirements reduce the speed to comparatively small limits, whereas the higher speeds are permissible on suburban roads. It follows therefore that the motors best adapted for one class of service are not those which are best adapted for another. The frequent stops necessitated in city thoroughfares naturally introduces the question as brought up by Mr. Baxter, whether the increased acceleration, which it is now attempted to attain by the use of large motors, is either best from an economical standpoint or demanded by the public. Furthermore, it is due to the higher speeds which have been maintained, and not to any inherent danger of the trolley, that most accidents have occurred. It is also certain that where the energy required in accelerating the velocity of a car becomes a large percentage of the total energy required of the car during its complete trip, motors designed to fulfil such conditions do not lead to the most economical results. The present conditions are to be mainly attributed to

the fact that the manufacturers of electric railway apparatus have found it easier to design high-speed motors rather than the slow-speed type of former years, combined with the fact that no demands have been made upon them for the slower speed machine. If street railway managers would carefully consider this question and finally decide that slow-speed motors would give a more efficient service, and that such shall be supplied bythe manufacturers, these machines will doubtless be made without much opposition.

ELECTROLYSIS AND MOLECULAR PHYSICS.

In the study of molecular physics it is necessary to bear in mind that the existence of atoms and molecules is simply a conception which affords a basis upon which to build up the science of physical chemistry, so that it is of the first importance that those engaged in this line of research should distinguish between mere theories and established facts. Electrolytic theories have undergone important and significant changes within the past 15 years, changes which have had a revolutionary tendency in the study of electrolysis and problems pertaining to molecular dynamics. Some of the various theories propounded as an explanation of electrolytic action beginning with the phlogiston theory of Stahl and followed by the oxygen theory of Lavoisier, the living-cell theory of Galvani, the contact theory of Volta, so long and successfully advocated and by some still adhered to; the theory of Grothuss, to the effect that each molecule of an electrolyte consists of two parts capable of being separated, each carrying with it its respective positive and negative charge, have all within the past few years received most severe checks by theories based upon the remarkable mathematical treatment of Willard Gibbs, the one American name standing with several of the most prominent foreigners. In the opinion of C. L. Mees—an abstract of whose address before the Physical Section of the American Association for the Advancement of Science will be found in other columns of this issue—the experimental work of Hittorf, commenced some 40 odd years ago, is to be considered as the fundamental basis for the modern views of electrolysis. The laws of Faraday will ever stand as a constant guide in the conception of electrolytic theories, and it was upon these that the work of Hittorf was carried on and followed up by Kohlrausch, who first pointed out the general law that the velocity of an ion in very dilute solution is dependent only on the nature of the solution and not upon the ions with which it is associated ; a fact which indicates a radical departure from the old theories, and at the same time justifies the conclusions of Hittorf to the effect that the ions migrate independently of one another. Add to this the experimental proof that the molecular conductivity increases with the dilution, and we have presented the dissociation theory so ably advocated by modern and prominent investigators. It is unnecessary to say that the theory of dissociation has, however, by no means been carried to its completion, several most important problems still remaining to carry out a conclusive demonstration of its correctness. The remarkable experiments of Pfeffer on osmotic pressure, so carefully interpreted by van't Hoff, clearly shows that similar laws to those which apply to gases apply to solutions, and that the kinetic energy theory may be made to include both. As pointed out by W. A. Noyes in his address before the Chemical Section of the American Association for the Advancement of Science, an abstract of which appeared in The Electrical World, Sept. 5, it was by combining the theories of electrolytic dissociation and osmotic pressure that Nernst built up his not generally accepted theory for explaining the E. M. F. of primary cells. Those who disagree with the concepts of this theory take exception to the idea of the existence of a solution pressure for metals similar to a vapor pressure in the case of liquids. Whether or not this conception is finally accepted, the two theories upon which it is based have received quite conclusive proofs of their correctness. The problems in physical chemistry having a special bearing upon electrolytic theories, and which now await solution, are many. Among those which have been pointed out may be mentioned the source of electric charge of the ions; the cause or causes of dissociation; the exact nature of conduction in solids and whether the same may be explained by electrolytic theories ; the determination of the heat absorbed by the passing of salts into solution; the nature of an electric conductivity in gases and the action of ultra-violet light and Röntgen rays on charged surfaces and their bearing upon electrolytic theories. These are but few of the problems open for investigation, and it is to be hoped that the splendid inaugural work of Willard Gibbs may be carried on to a successful issue by American physicists. These problems when solved will have opened up a vast field in molecular dynamics and will materially aid in clearing up present foggy concepts.

Western Union-Bell Telephone Affairs.

The subject of the relations between the Western Union Telegraph Company and the American Bell Telephone Company with reference to the expiration next November of the existing contract between the two concerns continues to engross general attention. No authoritative statement has yet been made regarding the probable action of the two companies, but many individual expressions of opinion are given, and from these an idea of the possibilities of the situation may be had. One gentleman, who claims to reflect Mr. George Gould's sentiments, states that when the Western Union-Bell Telephone contract expires it will not be renewed, because there is no reason why it should be, The present contract provides for the payment of royalties to the Western Union Telegraph Company on patents owned by it. Most all of these patents have run out and therefore it is argued the payment of royalties has practically ceased. At one time these royalties aggregated $600,000 a year, but now, so it is reported, they scarcely amount to anything. "The Bell Telephone Company," the gentleman states, "will, after Nov. 1, continue to attend to its own business, as it is now doing, and the Western Union Company will do the same."

One of the directors of the Bell Telephone Company expresses his opinion that the contract will not be renewed. The Bell Telephone Company, he states, was a weak concern when the agreement was made and the Western Union Company was a strong one. The Bell Company was the gainer at first, although it had to pay a large royalty, but hereafter it will not pay a royalty. He is credited with the statement that the agreement restricted the Bell Company in its work. It prevented the company from delivering messages which would be considered as encroaching upon the telegraph field. Hereafter it will be free from this restriction, which was especially disadvantageous in short-distance transactions. The Bell Telephone Company, he states, now reaches about 75 per cent. of the people in this country, and in New England the lines reach fully as many points as those of the Western Union, and probably more. He is of the opinion, however, that some sort of an agreement may be made between the two companies to compete with each other as little as possible, but with no restrictions upon either. He does not think that a violent competition will be engaged in on either side, and the report that the Bell Company will consolidate with the Western Union, he states, is entirely without foundation. The subject has not been discussed on either side. He points out the difficulty that would attend such an effort, for the reason that there are about 6000 stockholders in the Bell Company, holding on an average only about 39 shares each, and for this reason it would be difficult for any one to buy up a controlling interest in the stock for the purpose of bringing about a consolidation.

Drilling Marble.

In a recent application of an electric motor for drilling marble for attaching a balustrade to a staircase, it was found that a one-hp 110-volt motor would drill 25 holes a day, 1.25 inches in diameter and one inch deep.

A New Telephone Discovery.

BY F. JARVIS PATTEN.

The above is the title of an editorial in the New York *World* of Sept. 14. Referring to an alleged Russian discovery it says: "That by its aid distance is practically abolished, and an ordinary telegraph wire suffices to send music nearly a thousand miles with little loss of tone or volume."

The article then dilates upon the magnificent possibilities that lie in the invention of an automatic telephone "relay" or "repeater," which it is presumed the Russian has discovered.

All this is important if true, but why must these things always happen so far away, and why is it always so difficult to get at any facts in the case?

It is safe to say that we have in this country a thousand opportunities to investigate the telephone repeater problem to one that they have in Russia, and specially developed telephone brains in about the same proportion. We have able inventors familiar with all the conditions of the problem, and in fact all the electricians of the "old school" have had a "hack" at the "Phone Repeater." Edison was at it long ago, but appears to have given it up of late years. We find Moses G. Farmer prominent in the list, and many of those whose early ideas of electricity were acquired at the telegraph operator's table.

The telephone came before the public in 1877, and since that time several thousand United States patents have been issued for alleged telephone improvements, and among the whole lot we find less than 40 patents for telephone repeaters or relays, much less than 1 per cent. of all the telephone inventions patented.

As a matter of laboratory investigation and experiment I have put all these alleged repeaters into metal, and tried them with a view to determine, if possible, why a telephone repeater or relay could not be made that would *repeat*, and accomplish what the WORLD article suggests, namely: Long-distance telephony on ordinary wires, on the same principle that we now have long-distance telegraphy on such wires in daily use for telegraph service.

I have kept close track of this subject for several years, and it is a fact that the telephone repeater is practically abandoned to-day by American inventors, and there is no good evidence that others have any such knowledge of the problem.

My investigation of this subject has been thorough on both the practical and the theoretical side, and my experience convinces me that telephonic repetition from one line to another is destined to be one of the next steps in electrical advance. Last March I distinctly heard speech in a second line that was automatically transmitted from the first by a repeating telephonic relay, the speech being delivered in the second line with all the distinctness and certainty of ordinary telephonic transmission.

This is in fact the essence of telephonic relaying or repetition, for if it can be repeated once it can be done again and again. The instruments were connected in circuit by myself and other electrical experts, who could not be deceived as to the facts, and in view of such facts I am ready to assert that telephonic repetition or relaying of the message is to-day an accomplished fact in the second line, though I am free also to say that I do not think it is generally considered a physical possibility. The instrument and system used, both of which are exceedingly novel and simple, will be described at an early day.

Copper Production.

The production of copper in the United States, in long tons, for the eight months of 1896 ending August was 134,775 tons, an increase of 26,049 tons over the production during the same period in 1895. The European production for the same months was 57,124 tons, an increase of 523 tons. During the same period the exports of this metal from the United States were 78,322 tons, an increase of 33,579 tons as compared with the exports during the same period last year.

An Electric Lighting Plant Near the North Pole.

The Nansen expedition, which is at present exciting considerable interest, was provided with an electric light plant, the power for which was obtained from a windmill; it was used during the long drift of the *Fram*, through the Polar seas, and it is said to have fulfilled all expectations.

Measurement of Power in Two and Three Phase Circuits by Means of Wattmeters.

BY DUGALD C. JACKSON.

The principles underlying the methods of measuring power in polyphase circuits differ in no essential respect from those relating to single-phase circuits, but it is desirable to apply them in such a way as to reduce the number of necessary readings to a minimum. For satisfactory measurements, non-inductive wattmeters are of essential importance, and very satisfactory commercial portable wattmeters are now to be had for a reasonable price.

In the following *résumé* of the various ways in which wattmeters may be applied to the measurement of the power in polyphase circuits it has not seemed necessary to insert mathematical proofs of the soundness of the methods, as these have been fully set forth by such eminent men as Blondel, Gerard, etc.

TWO-PHASE SYSTEMS.

Independent Circuits.—In a two-phase system with separate circuits, independent wattmeter readings are taken in each circuit, and the total power is the sum of the readings. One wattmeter placed in each circuit (illustrated in Fig. 1), from which simultaneous readings are taken, is the best arrangement, but if two wattmeters are not to be had, one may be inserted successively in the two circuits, and the sum of the readings is equal to the power in the system provided the load does not vary while the readings are being taken.

If the circuit is perfectly balanced, twice the reading of a wattmeter in one circuit is equal to the power, but this is a condition which cannot be relied upon.

Circuits with Common Return.—Two wattmeters may here be used, one for each circuit, connected in the way shown in Fig. 2, and the power in the system is equal to the sum of the readings.

When the system is in exact balance the wattmeters may be connected as in Fig. 3, or one wattmeter may be used in the way illustrated in Fig. 4, but the condition of exact balance, as has already been remarked, is not to be relied upon, so that the arrangements shown in Figs. 3 and 4 cannot be safely used, except under exceptional conditions. When a single wattmeter is used in a balanced system, as illustrated in Fig. 4, the current coil is placed in the common wire, and a reading is taken with the free end of the pressure coil connected to one outside wire. The pressure coil terminal is then quickly transferred to the other outside wire and a new reading taken. The sum of the readings is then equal to the power sought.

THREE-PHASE SYSTEMS.

Three Wattmeters.—(*a*) If the power delivered by a generator or absorbed by a motor or other device which is connected in star or Y-fashion is to be measured, three wattmeters may be used, connected as shown in Fig. 5, provided the common or neutral point is accessible. It is evident that each wattmeter measures the power in one coil, so that the sum of the readings gives the power in the system. If the system is exactly balanced three times the reading of one wattmeter gives the power.

(*b*) If the devices are connected mesh or Δ-fashion three wattmeters can still be used, provided the current-coils of the wattmeters can be inserted directly into the coil-circuits, as shown in Fig. 6. The power in the circuit is equal to the sum of the three wattmeter readings, and if the circuit is exactly balanced three times the reading of one wattmeter gives the power.

(*c*) When it is impossible to insert the wattmeters in the coil circuits of a device with mesh connection, the three-wattmeter method may still be used by the creation of an artificial neutral point, as shown in Fig. 7. For this purpose one end from each of three equal non-reactive resistances are connected together, and the other ends are connected to the respective corners of the mesh circuit. If the system is balanced, the pressure between the neutral point and either corner is equal to $\frac{E}{\sqrt{3}}$, where E is the pressure of one coil, and the phase of this pressure is ϕ degrees in advance of the current entering the corner. A wattmeter with its current coil inserted in the circuit wire leading to the corner carries a current equal to $\sqrt{3}\ C$, and if the free end of the pressure coil is connected to the neutral point, the power reading of the wattmeter is

$$\frac{\sqrt{3}\ C\ E \cos \phi}{\sqrt{3}} = C\ E \cos \phi,$$

which is the power in the coil. This holds equally true for an unbalanced system. Care must be taken that the resistances of the wattmeter pressure coils are so large compared with the three auxiliary resistances that connecting them in circuit does not disturb the pressure of the neutral point.

If the resistances of the wattmeter pressure coils are exactly equal, auxiliary resistances are unnecessary, and the measurement

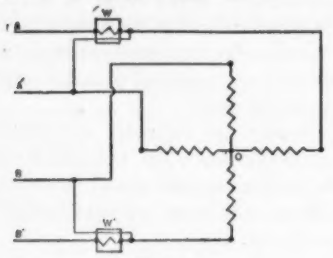


FIG. 1.

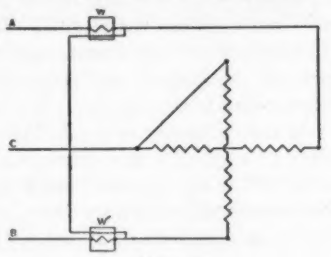


FIG. 2.

may be made by joining the free ends of the three pressure coils. The equality in the resistances of the pressure coils may be gained by inserting proper non-inductive resistances in series with them, as shown at r_1, r_1', r'' in Fig. 8.

These methods are independent of the condition of balance in the system.

Two Wattmeters.—The algebraic sum of the readings of two wattmeters inserted in a three-phase circuit as shown in Figs. 9 and 10 gives the power in the system with entire independence of the balance of the system or current lag; the only conditions affecting

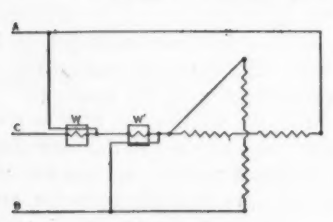


FIG. 3.

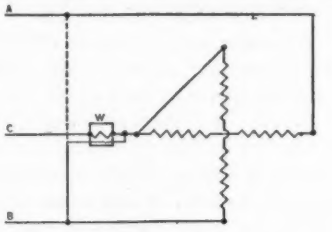


FIG. 4.

the soundness of this method are: (1) when the devices are connected in mesh fashion, as in Fig 9, the algebraic summation of the instantaneous pressures between the three lines A, B and C must always be equal to zero, or

$$e_{AB} + e_{BC} + e_{CA} = 0;$$

(2) when the devices are connected in star fashion, as in Fig. 10, the algebraic summation of the instantaneous currents in the three line wires A, B and C must always be equal to zero, or

$$C_A + C_B + C_C = 0.$$

When two wattmeters are used as here proposed and the equivalent current lag in the circuit is less than 60 degrees (*i. e.*, the power is greater than .50), the arithmetical sum of the readings of the two instruments is equal to the power in the circuit; but if the

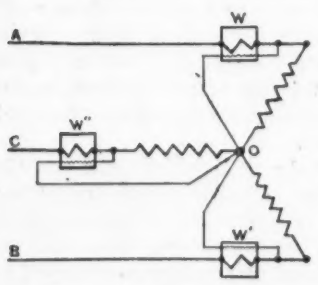


FIG. 5.

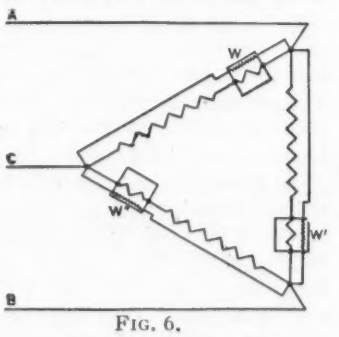


FIG. 6.

lag is greater than 60 degrees (*i. e.*, the power factor is less than .50), the relation of the currents in the current and pressure coils of one of the wattmeters causes it to have a negative reading, and the arithmetical difference of the readings of the two instruments gives the power. There is some difficulty in distinguishing which condition exists in many cases, especially when the power absorbed by partially loaded induction motors (in which the power factor is low) is under measurement. As a general rule, if the conditions do not make the case evident, the truth may be discovered by interchanging the positions of the instruments without altering the relative connections of their current and pressure coils. If the deflections of both needles are reversed, the difference of the original readings represents the power, but if the deflections are in the same direction as before, the sum of the readings is correct.

A double wattmeter, consisting of two fixed coils and two movable coils on one spindle, can be used in measuring power by the two-wattmeter method. Such an instrument of itself sums up the double reading algebraically, and a single reading gives the power. Record-

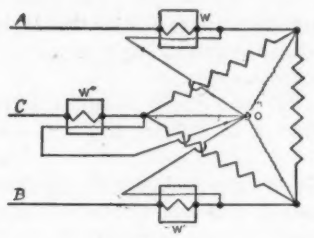


FIG. 7.

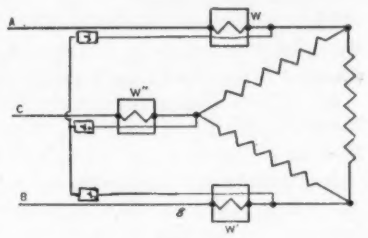


FIG. 8.

ing wattmeters based upon this principle can be made very useful in the commercial sale of power from three-phase circuits.

One Wattmeter.—In a balanced circuit one wattmeter may be very conveniently used by connecting the current coil in one wire and connecting the free terminal of the pressure coil alternately to the other two leads (Fig. 11), when the sum of the readings gives the power. For, the power reading of the wattmeter in its first

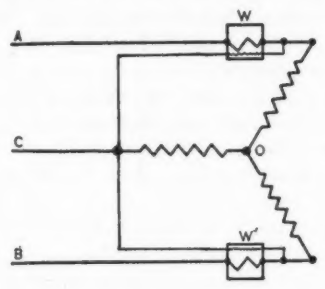


FIG. 10.

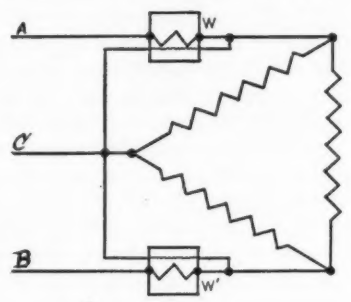


FIG. 9.

position is $\sqrt{3}\ CE \cos(\phi + 30°)$, and in its second position, $\sqrt{3}\ CE \cos(\phi - 30°)$, and the sum of the readings,

$$\sqrt{3}\ CE \{\cos(\phi + 30°) + \cos(\phi - 30°)\} = CE\, 3 \cos\phi,$$

where C E and ϕ are the current, pressure and lag in a coil; but $CE \cos\phi$ is the power in one coil and $3\ CE \cos\phi$ is the total power of the three coils, hence the one wattmeter gives correct indications *provided ϕ is the same for all the coils, and the load is uniformly distributed.*

A wattmeter having two independent pressure coils could be used as a direct-reading instrument for this purpose. A similar wattmeter could also be used in one-wattmeter measurements of power in two-phase circuits.

An ordinary wattmeter with one pressure coil may be used for the double measurement at one observation by connecting the free end of the pressure coil to the middle of a high non-inductive resistance which is connected between the two lines opposite to the one in

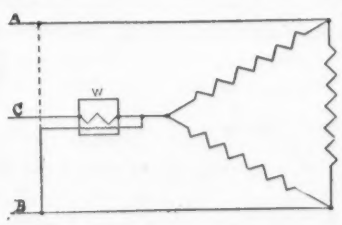


FIG. 11.

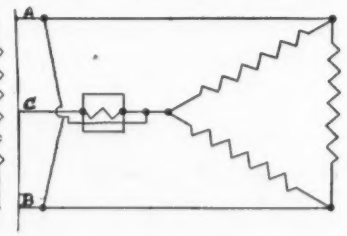


FIG. 12.

which the current coil is inserted (Fig. 12). This reading is evidently equal to the sum of the readings with the other arrangement, but the wattmeter constant must be determined with one half the high resistances in series with it.

The conditions italicized above is ideal rather than practical, so that this arrangement cannot be relied upon, and either three or two wattmeters must be used according to the arrangements illustrated in Figs. 5, 6, 7, 8, 9 and 10, for the purpose of measuring the power in a three-phase circuit under operating conditions. The two-instrument arrangement is correct in nearly all cases, and, of course, is the most convenient.

Electrical Features on the "St. Paul."

THE American line steamship *St. Paul* was placed in commission Oct. 9, 1895. She has a displacement of 16,000 tons and a tonnage of 11,621. The maximum speed on her trial trip was 20½ knots. The engines, of which there are two, are of the six-cylinder quadruple expansion type, the cylinders being 28½, 28½, 55, 77, 77, 77. There are six double-ended and four single-ended Scotch boilers generating steam at 200 pounds pressure. The maximum day's run of the *St. Paul* has been 540 knots, which figure, however, was not reached on the record-breaking trip in August last, the time of which was six days, no hours, 31 minutes, between the Needles and the Sandy Hook Lightship. The days' runs were as follows: 493.1, 524, 516.9, 525.1, 530.8, 456.2, which make a total of 3,046.1 knots.

It is of more interest, however, to the passenger to know the elapsed time between New York and London than between the Sandy Hook Lightship and The Needles. Any passenger on this trip could have left London at 10 a. m. on Saturday and reached New York City at 11 a. m. the following Friday.

The steamship *St. Paul* is 554 feet long, 63 feet broad and 43 feet deep, and is sub-divided into 17 water-tight compartments. With her large carrying capacity, five decks, 20,000-hp engines, splendid trimmings and finish, the *St. Paul* is one of the largest, fastest and finest ships that floats. She is a sister-ship to the *St. Louis*, the electrical features of which were described in THE ELECTRICAL WORLD, June 15, 1895. The two ships are similarly equipped, but many of the features of the *St. Paul* deserve a treatment by themselves. Electricity is applied wherever there is a chance for its use, and on the ship it forms a very important consideration. In a description of the various appliances and features, we will begin at the bottom of the ship and come up. We find installed in each shaft alley, as shown in Fig. 2 and diagrammatically in Fig. 4, a Pfatischer revolution indicator generator, manufactured by the Electro-Dynamic Company, Philadelphia, consisting simply of a small dynamo having a permanent field and fastened to the ceiling of the alley directly above the propeller shaft. The armature is belted to the latter, there being also an idle pulley used for taking up the slack. The E. M. F. of the little generator will change with a change in direction of the rotation of the main shaft and will also be proportional to the speed at which the main shaft is running. It follows therefore that if the generator be connected to a voltmeter located at any convenient point, the latter may be graduated to correspond to the number of revolutions the main shaft is making This is what is done. The scale of the indicator has 80 divisions,

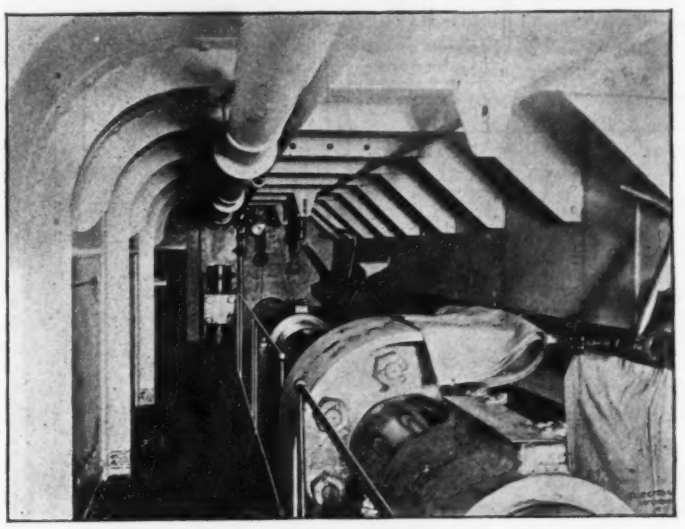


FIG. 2.—SHAFT ALLEY.

40 on either side of the centre. One indicator is located in the pilot house and the other in the chief engineer's room.

The position of the rudder at any moment is shown by the rotary indicator, the circuits for which are shown in Fig. 3. Fastened to the rudder post is an arm, which as the rudder moves makes contact over various sections of a 220-ohm resistance placed across the ship lighting circuit. The indicator similar in construction to the revolution indicator, but graduated so that its divisions represent angular positions of the rudder, has one binding post connected to the central position of the resistance, while the second binding post is connected to an arc electrically connected to successive contact points of the main resistance as the rudder turns. It is evident therefore that as the contact moves from one side of the neutral

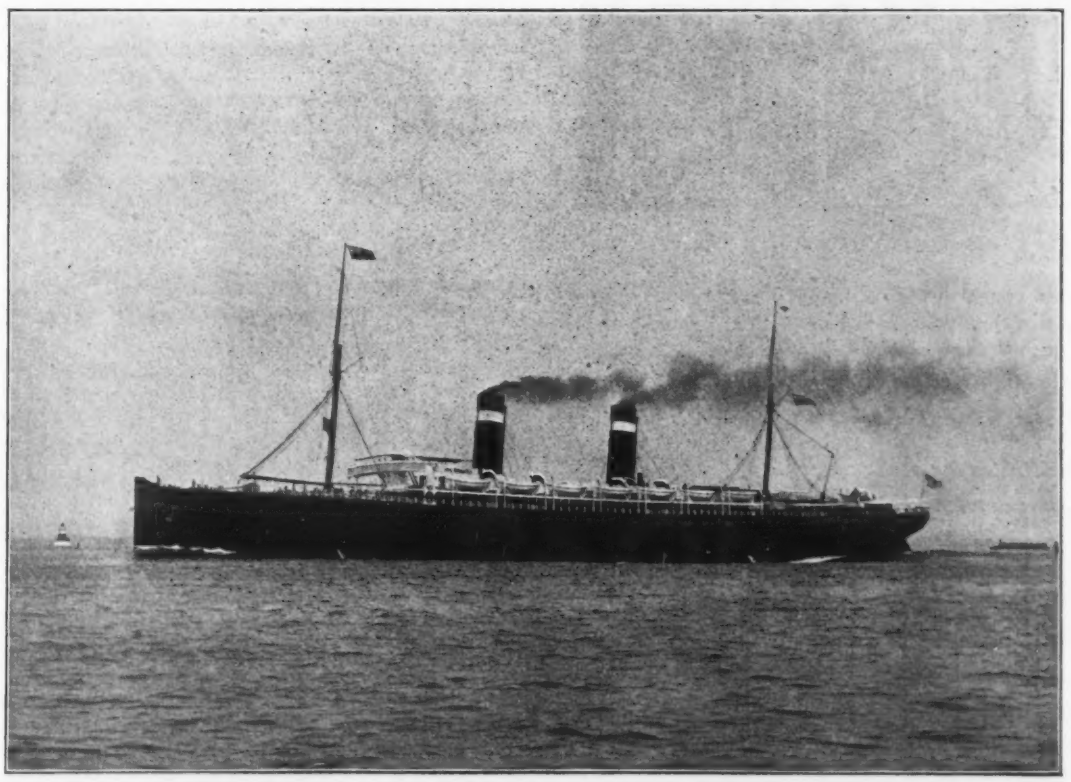


FIG. 1.—THE "ST. PAUL."

position to the other the current will be reversed, and the indicator needle point accordingly, the amount of the deflection depending on the angle through which the helm moves. Just above the floor and aft of the engine room is located the refrigerating room shown in Fig. 5, containing two Kilbourn refrigerating machines built by the Cox & Sons' Company, Bridgeport, N. J. Each ammonia compressor, making 266 strokes per minute, is driven through a cast steel gear and pinion by

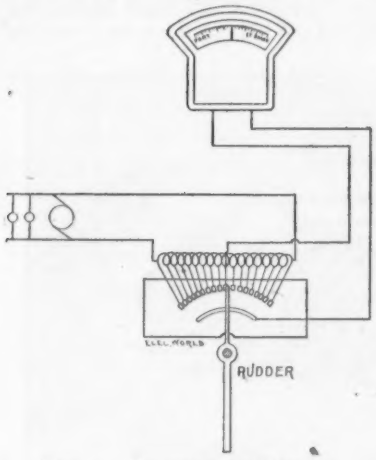


Fig. 3.—Diagram of Rudder Indicator.

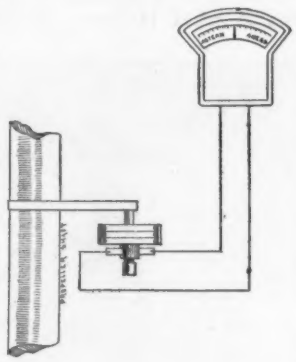


Fig. 4.—Diagram of Revolution Indicator.

a 10-hp two-pole motor running at 600 revolutions per minute. Each motor, as in fact almost the entire electrical equipment of the ship, was manufactured and installed by the Electro-Dynamic Company.

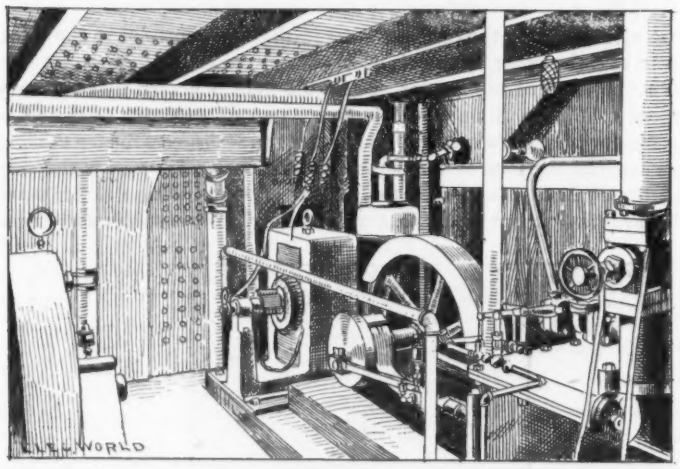


Fig. 5.—Ammonia Compressors.

The motors are series-wound and have an ordinary rheostat control. The main deck contains the dynamo room, which is located just forward of the main engine-room, and is entered from either side of the central bulkhead. Fig. 6 is a diagram showing the location of

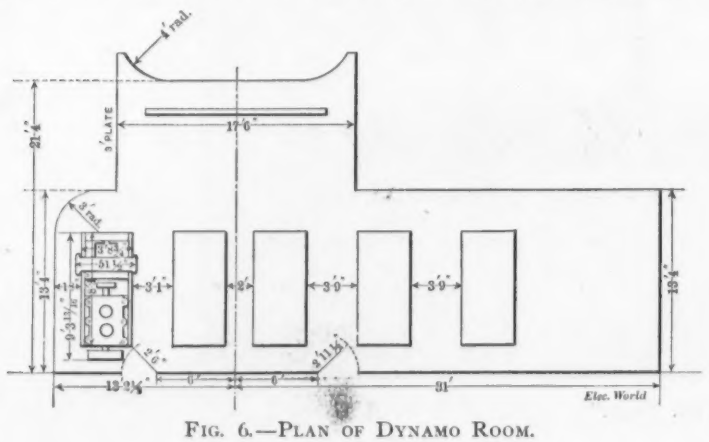


Fig. 6.—Plan of Dynamo Room.

the generating units and switchboard. There are five sets, three of which are shown in Fig. 11. The engines are of the automatic cut-off single-valve open double-upright pattern, and are rated at 75 horse-power each. They were built by the B. F. Sturtevant Company and operate with a very good efficiency, as will be seen from a consideration of the results of tests made by Mr. B. C. Loomis, to whom we are indebted for the accompanying data. The dynamos, built by the Electro-Dynamic Company, are of the four-pole type, compound-wound, have gramme-ring armature, smooth cores and a

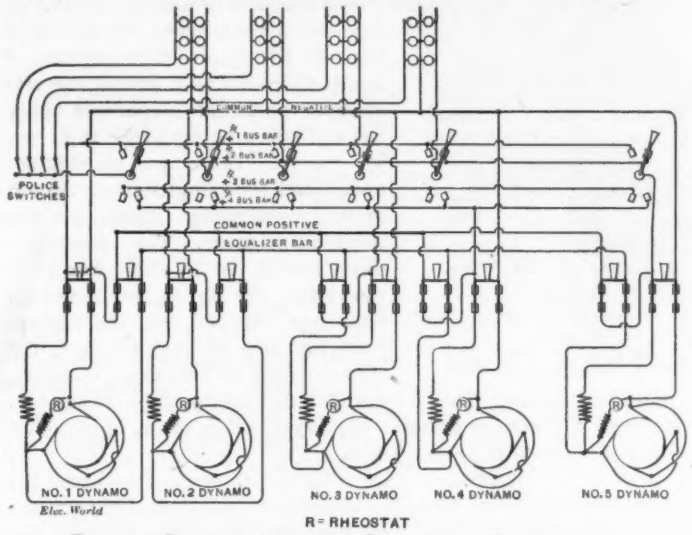
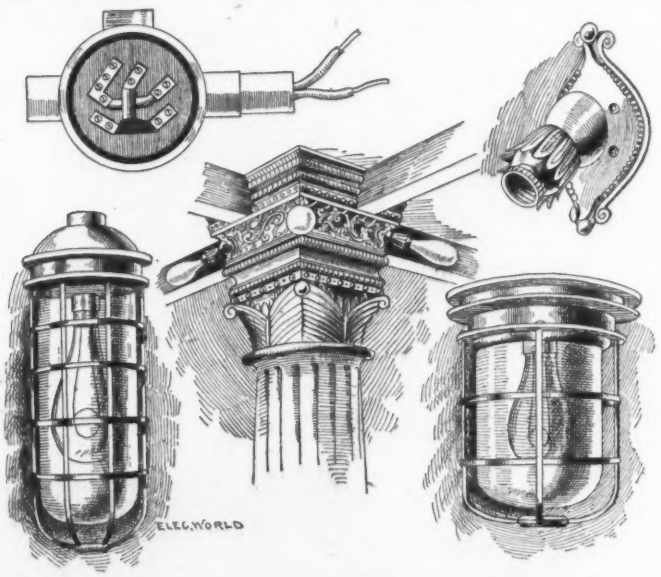


Fig. 7.—Switchboard and Generator Connections.

capacity of 360 amperes at 110 volts when running at 475 revolutions per minute.

The brushes, of which there are four sets of three each on each machine, are supported in brush-holders, which in turn are mounted in pairs on a sleeve which may be shifted by a small worm meshing in a rack tooth located on the bearing. This motion is positive and not likely to get out of adjustment. A special feature of these machines is the carbon-tip brush, which after being properly adjusted produces no appreciable wear on the commutator. The machines apparently run without the least sparking. The field magnets are of cast steel which has been carefully annealed, thus producing a high permeability and consequently a light frame. Equal potential differences between each pair of brushes is obtained by shifting the whole field frame so that the change in the magnetic reluctance



Feeder Pipe Junction Box. Engine Room Fixture.

Saloon Column. Fig. 8.

Saloon Column Fixture. Steerage Fixture.

due to a change in the length of the air gap varies the number of lines passing through the different parts of the field. This adjustment is done when the machines are set up, after which they require no attention. Each machine has self-aligning, wick-feed, self-oiling bearings. By the use of the wick-feed device the oil is automatically filtered, inasmuch as only pure oil will saturate the wick. Each engine is insulated from its corresponding generator by a fibre-coupling, and since both engine and generator have their own bearings they may be separated at any time with little trouble. The total space occupied by one generating set is not quite 10 feet long by 4½ feet wide.

Fig. 13 is a view of the switchboard. It contains two Weston voltmeters, one being used as a ground detector, and five Weston ammeters, all of which are flush with the face of the board. These instruments were carefully calibrated prior to making the tests, the results of which accompany this article. Carpenter enamel field-rheostats are used, these being fastened to the back of the board, only the contacts and handle appearing on the front.

Generating set No. 5, shown in Fig. 7, is a reserve unit, and its capacity is sufficient to carry the immediate current demands of the ship in case of failure of any one of the other units. It will also be seen from Fig. 7 that any dynamo may be thrown on any circuit or all may be thrown in parallel. Four leads run from each to its respective panel on the switchboard, although but three are shown in the figure, the fourth, which is the rheostat control, being locally connected for simplicity as shown in the diagram. Two of the three leads are the positive and negative of the dynamo, one of which goes to the negative bus-bar, the other having its own independent bus-bar. The remaining lead is the equalizer, also connected in each case to a common equalizer-bar.

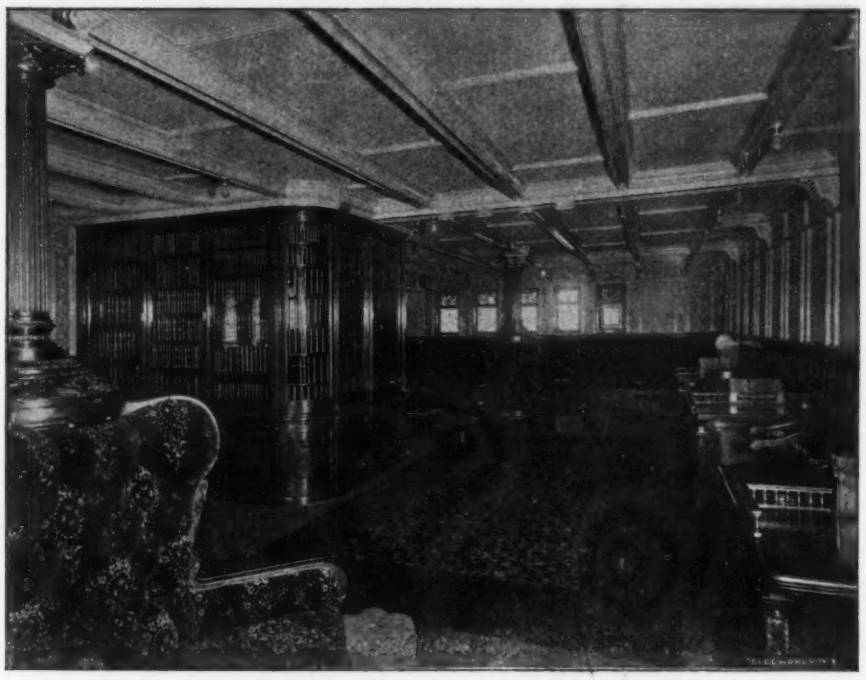


FIG. 9.—LIBRARY.

There are in all 18 lighting feeders supplying nearly 1800 16-cp lamps. The lighting feeders, a few of which are shown in Fig. 7, are made up of 3 conductors, of which one, having the current-carrying capacity of both the others, is used as a common return for the other two. Of these latter two, one supplies the lighting lamps used throughout the ship, and the second the night light and those used when the ship lies in port. The respective connections are shown in the diagram, Fig. 7. A drop of two volts has been allowed in each feeder when carrying its maximum load, calculated on a basis of 1000 circular mils per ampere. Each feeder is absolutely continuous, no splicing whatever being used. If a tap is made to a distribution centre, water-tight feeder junction boxes are always used, an interior view of one of which is shown in Fig. 8. Each feeder supplies from two to four distribution centres, from which branch circuits are taken off.

The distribution closets, such as shown in Fig. 14, are made water-tight, and each branch is provided with a double-pole fuse and switch. There are also two main switches controlling the general lighting and night lights respectively, without operating the branch switches. The fuses are visible through a plate glass window cemented in the door of a closet. Each branch circuit has on an average about eight 16-cp lamps connected to it. Single light branches are taken off by means of porcelain junction blocks with porcelain covers. This method is a great advantage, inasmuch as it permits of the easy location of any faults. These junction blocks have been used only in such parts of the ship where dryness is certain to be maintained. In the engine, cold storage and provision rooms, or in any damp places, or in those locations where sea water is likely to come in contact with the wiring, the wires are placed in iron-armored conduit made by the Interior Conduit & Insulation Company. The feeders are run in 1½-inch conduit to water-tight distribution centres, from which the branches run in three quarter inch iron-armored conduit. Individual lights are taken off by means of water-tight junction boxes with fuses for each lamp. All fixtures, switches and receptacles are thoroughly water-proof, and were especially constructed for the purpose. The wire used was selected after being carefully tested, and was supplied by the Safety Insulated Wire & Cable Company, of New York City, the specifications calling for 1000 megohms per mile at 100 degrees F. and 25 megohms at 200 degrees F. thus ensuring a good insulation at a high temperature. Special care has been taken in running the wires in order to avoid crossing those of opposite polarity. For instance, in wiring the two upper decks, the positive branch wires were run on one side of the ship and the negatives on the other side, the two meeting parallel on the beams on which the lights are placed, all wires at the same time being accessible.

In addition to the engine-room equipment thus far described there is a small Crocker-Wheeler motor transformer which is running ceaselessly and doing valuable service in supplying current at six volts pressure to some 20 annunciators and numerous bell and fire alarm circuits throughout the ship, this work being installed by Charles H. Corey & Sons, under contract with and according to the specifications of the Electro-Dynamic Company.

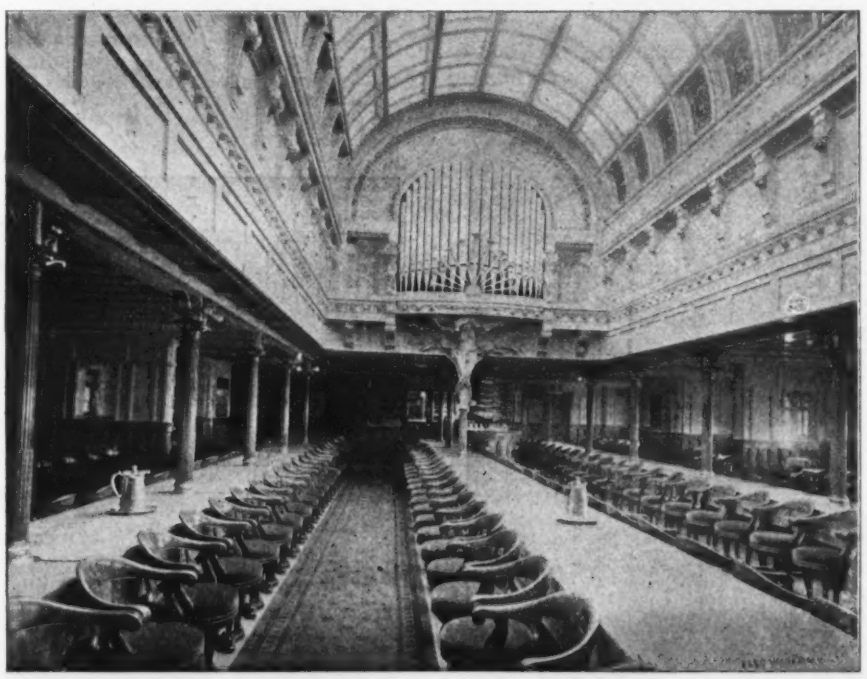


FIG. 10.—MAIN DINING SALON.

The motor service on the *St. Paul* is carried out on an extensive scale. There are no less than 16 motors, aggregating about 125 horse-power; four of five horse-power, two of seven horse-power, and two of nine horse-power each are used for running Sturtevant blowers. These are all located on the canopy deck, as shown in Fig. 17. The blowers are used for heating and ventilating in Winter and for ventilating alone in Summer. All blowers located on one side of the ship are used for forcing air through the respective compartments which they supply, while those symmetrically placed on the

opposite side of the ship are used for exhausting from the same compartments. During the Winter months the air from the former is forced through a nest of steam pipes so that it becomes warmed and in turn warms the rooms through which it circulates. The two motors operating ammonia compressors have already been referred to. Four Storey motors of 3½ horse-power are used for hoisting ashes from the fire-rooms. Another of 7½ horse-power is directly connected to a Morse & Williams elevator machine, shown in Fig. 12, which is used for hoisting provisions from the store-rooms The rheostat, it will be noticed, is located on the top of the motor, which is operated by a revolving switch fastened to the wheel, this wheel being turned by pulling a rope running through the elevator shaft. A small ½-hp motor is used for pumping the organ situated in the main dining saloon, a view of which is shown in Fig. 10. This organ is similar to that installed in the *St. Louis*.

Fig. 11.—Dynamo Room.

In the pilot-house, located just above the canopy deck, is one of the rudder indicators before referred to and shown in Fig. 15; also an automatic electric whistle blower operated by a clock, so that the whistle may be blown for 10 seconds during each minute or may be blown independently of the clock at chosen intervals. The whistle itself is operated by a magnet situated by the side of it. The signal may also be used as a telegraph for communicating with other vessels, the steam valve responding as quickly as the telegraph key can be operated. A push-button for this purpose is located just outside of the pilot house. The current used for operating the apparatus is but one half of an ampere, and may be supplied by a local battery circuit.

There is still another electrical arrangement in the pilot-house, shown in Fig. 18. This is a tell-tale device, consisting of a buzzer, three magnets and six switches. The latter throw in and out the port, starboard and masthead lights, each of which has two lamps and each lamp its own circuit running to the pilot-house. In case any lamp goes out the buzzer gives notice of the fact, having its circuit closed by one of the magnets. A rudder indicator mounted upon a pedestal is located on the bridge outside of the pilot-house.

Five pilot lamps, each representing a dynamo and mounted on a board, together with a Weston voltmeter, as shown in Fig. 19, are located in the chief electrician's room, so that he can tell if the proper regulation is being maintained and just what machines are running. Portable lamps are used throughout the ship. They have long, flexible cords, and are supplied with a plug having one projecting terminal and one internal, the socket being similarly made, thus the same polarity may always be maintained, offering a desirable feature. Large portable reflectors, each supplied with six 32-cp lamps are also used in the holds.

The type of fixtures used in the engine-room, saloon and steerage is shown in Fig. 8.

The 18 lighting circuits on the *St. Paul* are classified as follows:

1. First-class staterooms, upper deck, port.
2. First-class staterooms, upper deck, starboard.
3. First-class staterooms, main deck, port.
4. First-class staterooms, main deck, starboard.
5. Promenade deck, forward officers' quarters.
6. Promenade deck, amidship.
7. Saloon deck, forward.
8. Saloon deck, amidship.
9. Crew quarters, forward.
10. Crew quarters, aft and second-class smoking room.
11. Second-class staterooms.
12. Second-class saloon and first-class smoking room.
13. Steerage forward, upper deck.
14. Steerage forward, main deck.
15. Steerage, aft.
16. Galley and store-room elevator motor.
17. Engine and fire rooms, port.
18. Engine and fire rooms, starboard.

MOTOR CIRCUITS.

1. To forward mast (heating and ventilating).
2. To forward funnel, hurricane deck (heating and ventilating).
3. To aft funnel, hurricane deck (heating and ventilating).
4. To second cabin smoking room (hurricane deck, heating and ventilating).
5 & 6. Refrigerating machines.
7. Ash hoist motors, port.
8. Ash hoist motors, starboard.

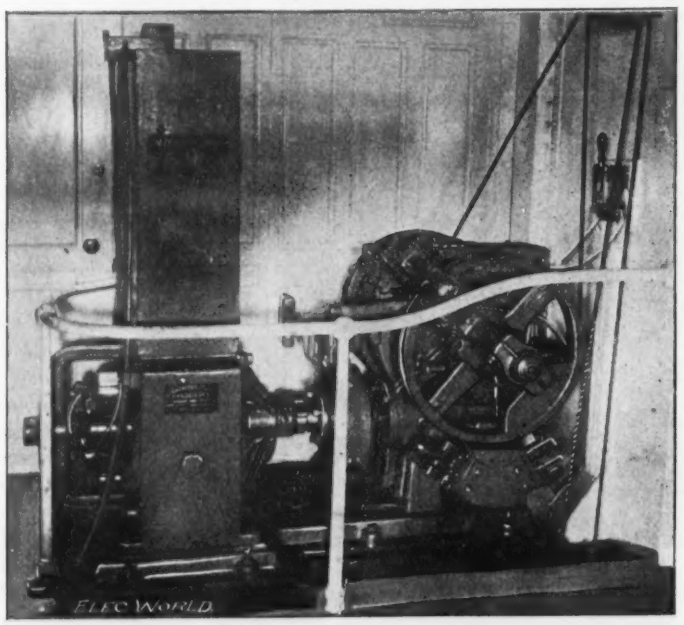


Fig. 12.—Elevator Machine.

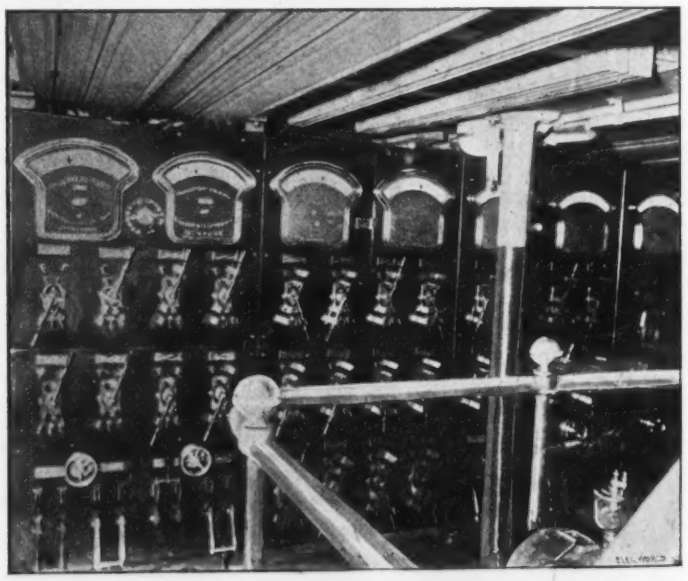


Fig. 13.—Switchboard.

The efficiency tests were made on generating set No. 4. The resistance of the series coil was .0014 of an ohm. The resistance of

the four sections of the armature, 40 coils each, was .0101 of an ohm. The shunt resistance at 110 degrees F. was 26.28 ohms. The

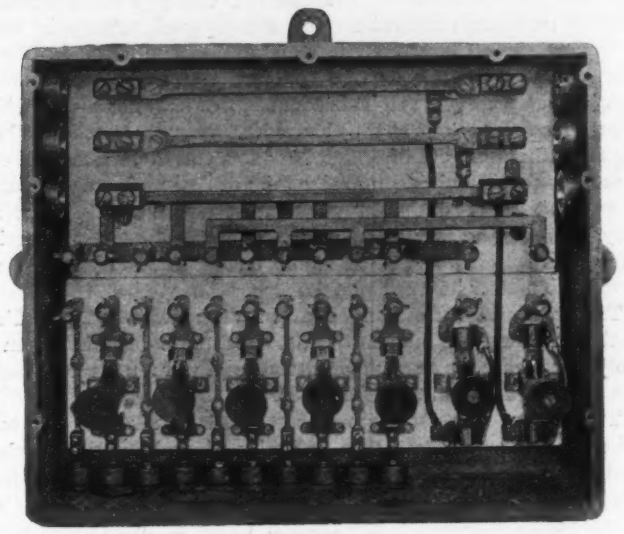


FIG. 14.—DISTRIBUTION CLOSET.

TABLE I.

Revolutions.	Volts.	Amperes.
471	110.0	0
469	112.0	100
465	112.5	200
462	112.5	300
460	112 0	360

TABLE II.

Horse-power.	Watts output.	Engine efficiency, in per cent.	Dynamo efficiency, in per cent.	Plant efficiency, in per cent.
74.4	39,405	81	88.9	71
73.6	39,600	80.9	88.9	72
70.8	37,800	79.2	88.5	70.1
54.6	25,615	73.3	84.6	62
27.16	9500	63.7	73.6	46.9
33.19	11,750	61.7	77	47.5
17.34				
13.97				

114 volts Field thrown in.
Due to friction.

E. M. F. of the dynamo, with 112 volts at the terminals, was 116.17 volts.

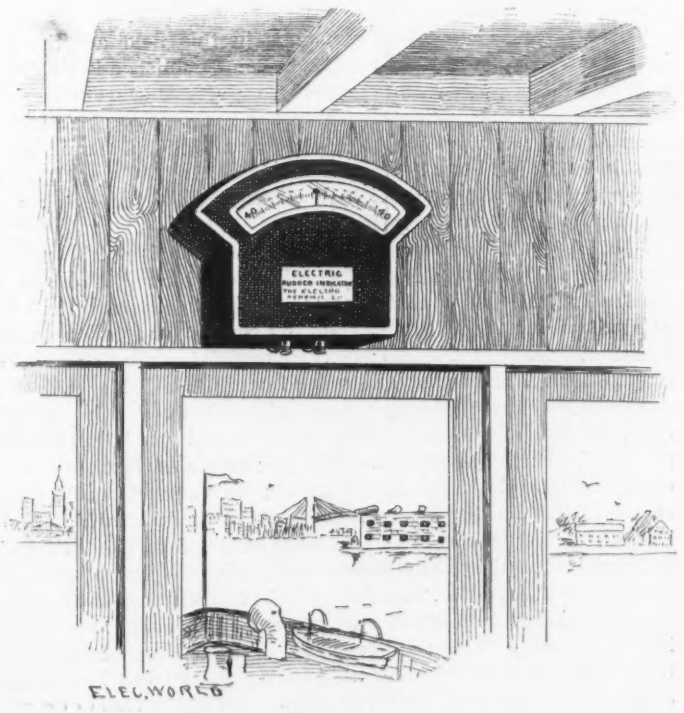


FIG. 15.—RUDDER INDICATOR.

Table I. gives the combined characteristic of the machine for loads varying from nothing up to 360 amperes. The engines were carefully indicated for each load. The steam pressures varied from 60 to 80 during the tests.

Table II. gives the commercial efficiencies of the engine and

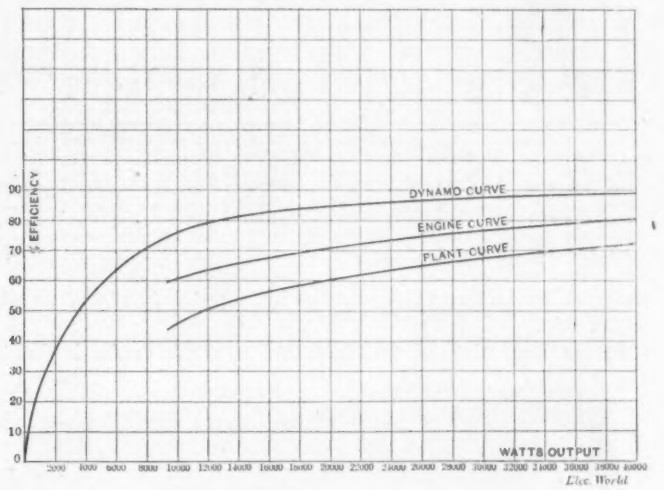


FIG. 16.—EFFICIENCY CURVES.

dynamo separately and the total efficiency of the combined plant. In Table III. the dynamo losses are tabulated for various loads.

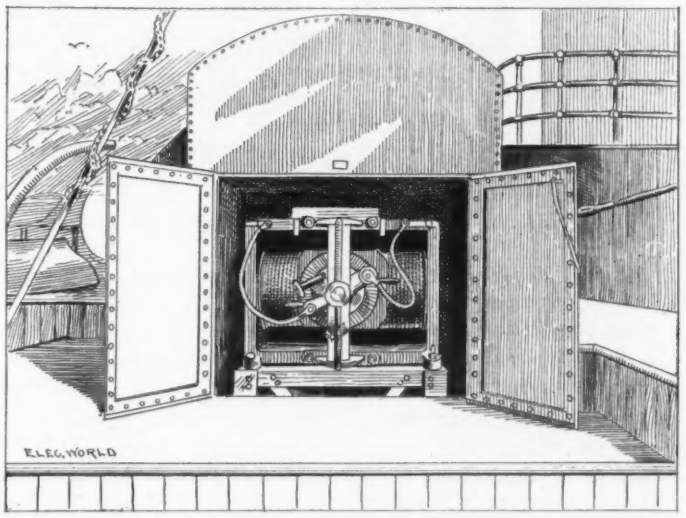


FIG. 17.—VENTILATOR MOTOR.

Other features of the *St. Paul* are not unlike those on the *St. Louis* and were covered in the article previously referred to.

The entire electrical equipment was installed under the super-

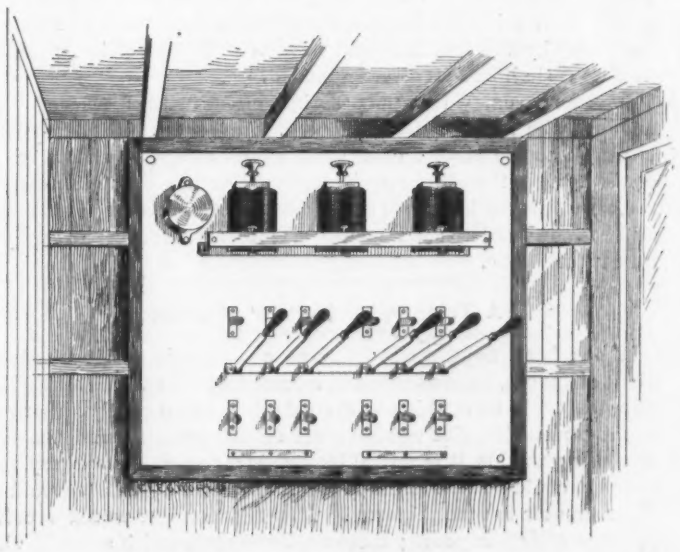


FIG. 18.—TELL-TALE FOR SIGNAL LIGHTS.

vision and specification of Mr. Matthias Pfatischer, representing the engineering department of the Electro-Dynamic Company. We are

indebted to Mr. Edward Wishart, chief electrician on the *St. Paul*, and Mr. W. Scott, superintending shore electrician and the International Navigation Company, for information furnished us relating to the ship.

TABLE III.

Current.	Watts lost in armature.	Watts lost in Shunt.	Watts lost in series.	Watts lost due H. F. and friction.	Total watts lost.	Watts input.	Total watts output.	Voltage lost in armature resistance.	Voltage lost in series coil.	Voltage generated with 112 btw. term.	Efficiency.
10	1.01	272	.14	3254.16	3527.31	4647.31	1120	.101	.014	112.115	.124
50	25.25		3.5		3554.91	9154.51	5600	.505	.07	112.575	.611
100	101		14		3641.16	14841.16	11200	1.01	.14	113.15	.761
150	227.25		31.5		3784.91	20584.91	16800	1 515	.21	113 725	.816
200	404		56		3986.16	26386.16	22400	2.02	.280	114.3	.848
250	631.25		87.5		4244.91	32244.91	28000	2.525	.35	114.875	.868
300	909		126		4561.16	38161.16	33600	3.030	.420	115.45	.880
360	1308.96		181.44		5016.56	45336.56	40320	3.636	.504	116.14	.889

In the execution of this installation, much credit is due to the electrical department of the Wm. Cramp & Sons Ship & Engine Building Company, in charge of Mr. Charles Dougherty, its electrical engineer.

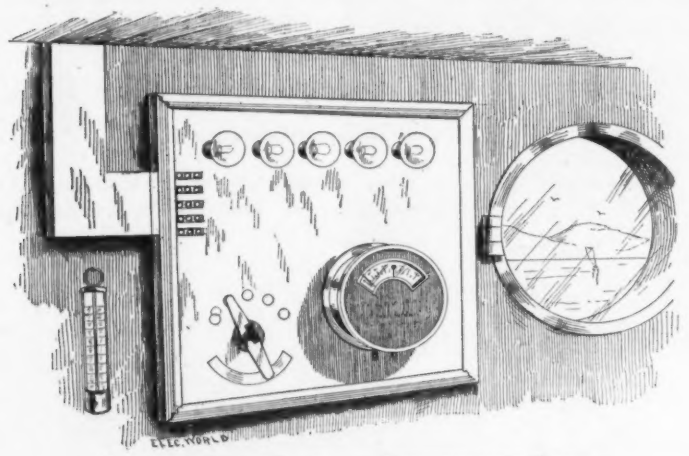


Fig. 19.—Pilot Lamps in Electrician's Room.

Cable Codes.

The International Telegraph Convention, whose headquarters are at Berne, Switzerland, on Sept. 1 addressed a circular to its members giving the results of the last conference, which was held in June of this year in Budapest. It will be remembered that a cipher vocabulary was submitted to the conference with the view to its adoption and compulsory use, but owing to the opposition that came from certain quarters it was decided that further action in the premises be indefinitely postponed.

The conference also ordered that, "Beginning with a date to be fixed by a subsequent conference, all the words used in private telegrams written in code language must be taken from the official code drawn up by the International Bureau of Telegraphic Administration, as it shall be hereafter expanded."

In order to carry this purpose into effect with the least friction and with the most regard for existing interests, the bureau will introduce into the official code such words as are found in private codes as meet the other requirements of Article 8, which relates to the conventional language of telegrams. Owners of private codes will be requested to send copies of the same for collation by the bureau at Berne.

A Telegraphic Unit in Astronomy.

It has been suggested to use as a new unit of length for very great distances, such as those in astronomy, over which an electrical impulse could be sent in one second; it is assumed that in one second a current impulse would travel seven times around the earth. According to this it is stated by an Austrian contemporary that a message could be sent to the moon in one second while it would take eight minutes to reach the sun, The nearest star would receive a message after four years; there are fixed stars which are still visible which to-day would not have received the news of the discovery of America while there are still others at which the news of the birth of Christ would not have been received.

Electrolysis and Some Problems in Molecular Physics.*

BY C. L. MEES.

By electrolysis we mean the chemical changes which result from passing an electric current through a compound, usually in solution or in a state of fusion. The substance decomposed is called the electrolyte. The electrolytic decomposition may be accompanied by chemical action occurring subsequent to or simultaneously with the appearance of the ions at the electrodes; the substance formed differing from the ions actually carried to the electrode. Changes of this character considerably complicate the problem and make the correct interpretation of observed phenomena difficult. This general law may, however, be enunciated: any electrolyte under the action of current is split into two, and only two, parts—atoms or groups of atoms, no matter how complex its structure may be.

The wondering attention of early investigators had been directed to the curious phenomenon that the substances resulting from electrolysis appeared only at the electrode and were not recognizable in the solution between the electrodes.

The various theories propounded to explain this vied with one another in improbability. The difficulty of explaining this behavior, seems to have led to the abandonment of the problem until, in 1805, Chas. J. D. Freiher von Grothuss propounded a theory which gave a sufficiently reasonable explanation to be adhered to for 50 years, and even quoted to-day in many text books.

Important experimental contributions followed one another rapidly, batteries were perfected, many physical actions of the electrical current were studied, the action of the current upon magnets was discovered, measuring instruments for quantitative work were invented, Ohm's law was enunciated, etc., so that when Michael Faraday, with matchless experimental genius and wonderful breadth of view, attacked the problem of electrochemical action, he had at his command the means for quantitative work in this field, which enabled him to discover and formulate one of the most important laws of electrolysis.

The law—that the quantity of electricity which is required to decompose a certain amount of a certain electrolyte is equal to the quantity which would be produced by recombining the separated ions in a battery, clearly showing the reversibility of the process—at once makes the problem one capable of theoretical treatment from the standpoint of conservation of energy. Faraday, in the main, accepted Grothuss' hypothesis, differing from him in the conception of the character and manner of action of the forces.

Faraday, though somewhat confused in his nomenclature, brings out very clearly the relations between quantity of electricity and quantity of material separated, and electrical potential and chemical affinity, though at that time the concept of energy and work done, as a function of both potential and quantity of electricity, was not clearly established.

The contributions of Williard Gibbs in this field are the most important, though scarce appreciated. Being published in the Transactions of the Connecticut Academy, 1876-78, they were not very accessible and not generally known. This great work anticipated the many discoveries since made experimentally in a manner all but final in its comprehensiveness and completeness, and opened out and suggested experimental investigations only partially undertaken and beginning to be carried out to-day.

About 1853 Hittorf quantitatively investigated with great care the change of concentration in solutions of electrolytes about the electrodes when a current passes. This phenomenon had been noticed and studied to some extent by Daniell and others without, however, having been made use of in explaining the nature of electrolytic action. Hittorf's studies and conclusion bring us into the very midst of the modern views of electrolysis. Taking a simple case, let two electrodes of copper be placed vertically over one another in a solution of copper sulphate; pass a current through the cell making the lower plate the anode; no very noticeable change occurs other than that copper is dissolved at the anode and deposited at the cathode; if after the current has passed for a short time it is interrupted and the electrode short-circuited through a galvanometer, a current will for a short time flow into the cell from cathode to anode; that is, in a direction opposite to the one which it has passed through in electrolyzing. The counter E. M. F. in this case cannot result from polarization at the electrodes, for no change has been brought about at their surfaces, such as a gas deposit in the case of decomposition in acidulated water with platinum electrodes. If the electro-

* Abstract of address before the Physics Section, American Association for the Advancement of Science.

lyzing current be continued for some time it will be seen that the solution about the anode has become more concentrated and more dilute about the cathode; the total quantity of copper salt in the solution has, however, remained the same. The counter E. M. F. above referred to is due to this change in concentration.

The first step toward the decisive establishment of the fact of the migration of the ions toward the plate would depend on an experimental measurement of the rate of migration was accomplished by Hittorf and led to the enunciation of these laws:

First: The change in concentration due to current is determined by the motion which the ions have in the unchanged solution.

Second: The unlike ions must have different velocities to produce such change in concentration.

The numbers which express ionic velocities mean the relative distance through which the ions move between the salt molecules, or express their relative velocities in reference to the solution; the change in concentration being a function of the relative ionic velocities. Hittorf's analysis enabled him to give their numerical values. A great many such have been made by him, Nernst, Loeb and others; these results show that in dilute solutions the relative velocities of the ions is independent of the difference in potential between the electrodes, if the current be steady, and that they are only slightly affected by temperature.

Hittorf points out that a knowledge of the specific resistance of electrolytes should give valuable information in reference to the nature of electrolytic action. It remained for F. Kohlrausch to devise a method, using an alternating current, by means of which accurate results were obtained. In connection with Hittorf's work Kohlrausch recognized that according to Faraday's law the conductivity should be represented by the sums of the velocities of the ions, each carrying its electric charge. Thus having from experimental data on conduction the sum of the velocities and from Hittorf's migration constants, based upon changes in concentration, the ratio of the ionic velocities, the absolute velocities of the ions would be calculable. Inasmuch as the quantities he was to deal with were groups of atoms or molecules he determined at once to make the molecule his unit of quantity, and not mass alone.

This expedient simplified the comparison of results and has been neglected by physicists. The comparison of results obtained by making the molecule the unit revealed at a glance relations between the physical behavior of different substances which would have been obscure if the mass had been chosen as unit. The selection of the most convenient proper unit is of great importance in the interpretation of results and the enunciation of physical laws.

Kohlrausch expressed the concentration in gramme molecules per unit value of solution, the unit solution containing a number of grammes of the electrolyte equal to the number expressing the chemical equivalent on the hydrogen scale. The measurements were then made upon solutions, the relative numbers of molecules in which were known. The ratio between the conductivity and the number of gramme molecules contained in the solution will then give molecular conductivities.

The results of such measurements show that:

As dilution increases there is an increase in molecular conductivity and that in very dilute solutions it approximates a limiting value. This increase of conductivity is considerable for bad conductors, less so for good conductors. The limiting value in dilute solutions of good conductors can be reached. In bad conductors, even at the extremest dilution accessible to measurement, the molecular conductivity is still far from the limiting value.

In general there is an increase of conductivity with increase of temperature amounting usually to about 2 per cent. per degree centigrade.

The conductivity of equivalent quantities of neutral salts is of much the same order of magnitude, usually reaching the limiting value at a dilution of about $\frac{1}{2000}$ gramme equivalent. From Kohlrausch's numerical values and Hittorf's constants the absolute velocity of a large number of ions was calculated. It appears from this that the velocity of the ion in very dilute solutions depends only upon its own nature and not upon the nature of the ions with which it may have been associated. Thus the velocity of the chlorine ion was found to be the same, whether found from solutions of KCl, NaCl, HCl, etc.

From this important general law was also found that the conductivities of neutral salts are additively composed of two values, one depending only upon the metal or positive ion, the other upon the acid radical or negative ion. According to this law the conductivity of a neutral salt can be calculated from a knowledge of the velocities of the ions independently, a test which has been applied in many cases with very satisfactory results when checked experimentally. For quite a number of compounds, however, the computed results were much too high. This law confirms the independent migration of the ions.

About 1887 electrochemistry entered into a new stage of progress; the central figure among those who were mainly active in bringing about this development was Arrhenius, who, together with Ostwald and others, advanced a theory of electrolytic action explaining very satisfactorily many known phenomena.

The first work done by the current is the overcoming of the viscous resistance of the medium, not an inconsiderable amount; thus a portion of the energy of the current is dissipated as heat.

At the electrodes another kind of work has to be done. Either the charges have to be removed from the ions, changing them into the molecule condition, or new ions must be produced from the material of the electrode and the solvent.

Undissociated molecules of the electrolyte take no part directly in electrolysis, except in so far as they may alter viscous resistance of the solution.

The fact that molecular conductivity increases with dilution means that as infinite dilution is approached complete dissociation or ionization of the electrolyte is effected.

The ratio between molecular conductivity at greater concentration and infinite dilution expresses the degree of dissociation or ionization. The conductivity can always be expressed by the sum of the velocities of the ions into a coefficient expressive of the degree of dissociation.

One of the important points in this theory is that solution affects dissociation. Chemically pure substances such as HCl in the liquid state should not be electrolized. Such is found to be the case. The curious fact that pure HCl and pure water alone are non-conductors, but become electrolytic conductors when mixed, is not rationally explained, other than that dissociation results. Why it takes place, we do not know; that some change in the associated energy always takes place we do know. In general, unless some chemical change occurs, solution is accompanied by refrigeration (except in the case of gases). It is probable then that some of the heat energy taken from the mixture is concerned in this dissociation.

In the case of fused substances heat may be a considerable factor in dissociation.

The question whence comes the electric charges upon the ions is not solved. Whether they are inherent in the molecule and become free by ionization or whether they result from the work done upon the molecules in dissociation is not known, Some progress has been made toward the solution of the question by Ostwald, who succeeded in measuring the heat energy of ionization in a few cases. This problem is one that should be carefully studied.

An objection to the theory of the existance of free ions in a solution has been urged from the chemical side, namely that the ions possess different properties from the atoms or atomic groups. It seemed remarkable that a potassium ion should be capable of existing in water without combining with the oxygen, as would be the case in the ordinary atomic or molecular condition. If we consider, however, that the amount of associated energy in the two conditions is different, it is not difficult to imagine different properties. We know, for instance, that negatively charged zinc will not act on hydrochloric acid, that several elements exist in well-known allatropic conditions, showing quite different properties. We explain this by different amounts of the associated energy which in some cases is quite measurable.

The difficulty of applying Ohm's law in the case of Grothuss and Faraday's theory disappears in the case of the dissociation theory, as it rather becomes a necessary consequence of it. Considering now a few phenomena not directly involved in electrolysis evidence in favor of the dissociation theory may be found.

Substances form solutions when a homogeneous mixture results the constituents of which cannot be separated by mechanical means, the proportion between the parts being continuously variable between certain limits with a corresponding continuous variation in properties.

(*To be continued.*)

Röntgen-Ray Experimenting.

Dr. Wm. J. Morton advises every experimenter to develop his own pictures in order to study his work, and states that a weak negative intensified is often much more beautiful than a stronger negative due to a longer exposure to the rays.

The Most Economical Cut-Off for Steam Compression.*

BY HENRY T. EDDY.

Some misapprehension seems to have prevailed as to the precise purport of the relation to each other of certain demonstrations that have been given respecting the most economical point of cut-off or the best ratio of compression. With a view of clearing up this misapprehension the author proposes, in the present brief review, to state the results of a recent investigation of the question based on the usual supposition of hyperbolic expansion and compression curves. The approximation thus obtained will serve to make sufficiently clear those points to which it is desired to attract attention, but the more complicated methods of obtaining results of a similar general character which will approximate still more closely the actual curves of the indicator card will be deferred to some future occasion.

1. Suppose the problem be to find the best ratio of compression in case the data given are these, viz.: The volume of the steam cylinder, the volume of the clearance, the pressure during admission, the back pressure of exhaust and the ratio of exhaustion.

This problem has been solved in analytical form by Prof. Cotterill,[1] and also by Prof. Burkitt Webb.[2] Prof. Webb has shown that the result may be graphically represented upon the indicator card, as follows: Prolong the expansion curve until it intersects the exhaust pressure line, and find the area thus added to the indicator card. Cut off an area equal to this from the top of the indicator card by drawing a horizontal line parallel to line of zero pressures. Then the point at which this horizontal line intersects the vertical clearance line will be a point of the best compression curve, to accompany the given expansion curve, admission line and exhaust.

It appears at once from the analytical results of the present author that the ratio of compression thus obtained will always be greater than the given ratio of exhaustion, provided the exhaustion be incomplete.

The same result is evident from the graphical construction just given, and appears also when due consideration is given to the circumstance that the best ratio of compression must be between the ideal case of complete compression and a ratio equal to the given expansion.

2. But suppose, conversely, that we proceed to inquire what is the best ratio of expansion in case the data given are these, viz.: The volume of the steam cylinder, the volume of the clearance, the forward pressure of admission, the back pressure of exhaust and the ratio of compression. The analytical solution of this question leads to results analogous to those previously obtained, which also admit of graphical construction as follows: Prolong the compression curve until it cuts the admission pressure line and measure the area thus added to the indicator card. Cut off an area equal to this from the bottom of the indicator card by a horizontal line parallel to the line of zero pressures. Then the point at which this horizontal line intersects the vertical expressing the total volume of cylinder and clearance will be a point of the expansion curve of best admission cut-off to accompany the given back pressure, forward pressure and compression. It can be shown analytically or graphically or from general considerations that the ratio of expansion thus obtained will be greater than the given ratio of compression.

3. It is evident that neither of the foregoing results is such as to enable us to determine the best relative points of cut-off for both exhaustion and compression.

For, if we were to follow their indications and start with a given ratio of exhaustion (not complete) we should find the best ratio of compression to accompany it to be greater than it is; and if expansion be obtained to accompany this compression, that must be still larger; and so on, stroke by stroke.

This requires that the cut-off for compression and for expansion should become, step by step, and stroke by stroke, more and more nearly complete. The conclusion thus arrived at is in entire accordance with our knowledge of the fact, that (on the basis on which we are now proceeding,) complete expansion and complete compression are theoretically best; and our results so far show simply that starting with any ratio less than that, we should be led to approach complete expansion and compression step by step rapidly instead of changing the ratio suddenly. This step by step increase of ratio, however, in a cylinder of given volume, involves the admission of a smaller and smaller weight of steam per stroke until complete expansion is attained. But since practical considerations forbid complete expansion, it is evident that such an investigation of the question as we have just described does not lead, as has heretofore been frequently assumed, to the solution of the problem of the most advantageous relation between the ratios of compression and expansion.

The same conclusion as to the inapplicability of results obtained in this way would evidently hold against a similar investigation based on some other and more accurate law of expansion and compression than the hyperbolic law. The difficulty lies not in the law but in the statement of the problem, which should evidently contain limitations nearly as follows:

4. To find the best ratios, both of expansion and compression, when the data are the volume of the cylinder, the volume of the clearances and the volume of the steam admitted per stroke, together with the forward-pressure during admission and the back-pressure during exhaust. On investigating the question analytically the best adjustment is found to occur when the ratios of expansion and compression are equal.

More work is therefore performed by a given volume of steam, admitted other things being equal, in case this adjustment of ratios is made, than when the adjustment is in accordance with either of the results previously found.

The conclusion now reached will evidently require but very inconsiderable modifications to adapt it to the comparatively small deviations from hyperbolic expansion which occurs in practice.

* Abstract of a paper read before the American Association for the Advancement of Science.

1. *Steam Engine*, second edition, p. 257.

2 Proceedings A. A. A. S. for 1893, p. 119.

A Portable Apparatus for Photographing Curves of Two Variable Currents Simultaneously.*

BY H. J. HOTCHKISS.

In the study of phenomena accompanying alternating or variable currents it is often desirable to have a continuous record of variations that occur in a small fraction of a second. If the variation of current is one that cannot be accurately reproduced a great many times the various instantaneous contact methods fail to give the desired results, since they make up the wave form by recording points in different parts of many waves far apart. Furthermore, in taking alternating-current curves by such methods it is necessary to connect the contact maker to the shaft of the generator or to a synchronous motor.

The aim in designing the apparatus presented was to provide a portable instrument similar to a hand camera, which will give continuous simultaneous records of two alternating currents of potential differences so as to show their phase relations, and which may be used wherever desired on the line without contact maker or synchronous motor.

It consists essentially of two quick-acting galvanometers, with minute needles and strong fields, mounted one above the other in one end of a case about 6 x 6½ x 18 inches, and a revolving drum carrying a photographic film in the other end. Reflectors, hinged to the side, throw sun light or arc light in through narrow slits upon the mirrors (which are smaller than a pin head) from which the two beams are reflected upon a horizontal slit in the drum box. As the needles are deflected the small spots of light move along the slit and the film moves at right angles to it, thus tracing the curves.

The galvanometer is somewhat like M. Blondel's oscillograph ;[1] the most prominent difference being in the moving parts. The needle consists of a minute, very thin piece of soft iron and a smaller piece of mirror, which are mounted on opposite sides of a quartz fibre. This in turn is mounted in the axis of a cylindrical rod $\frac{1}{8}$ inch in diameter, having a $\frac{1}{16}$-inch groove cut in the side lengthwise. The free portion of the suspension is about ¼-inch long. The needle rods and coils for different uses are interchangeable. These and the soft iron pole-pieces of the permanent magnet are held in their proper positions by a two-part rubber block. The needles vary in natural vibration frequency between 6000 and 17,000 single vibrations per second. If sunlight is used there are no electrical connections besides those for the two currents to be recorded. No lenses are required.

The drum end of the case may be removed and replaced by a slideway for using plates instead of films.

The adjustments are quickly and easily made, and the photographic mechanisms are operated by simply pressing a button.

The same galvanometers may be used for tracing such curves as characteristic of dynamos, in which current and potential difference

*Abstract of a paper read before the Buffalo meeting of the American Association for the Advancement of Science.

1 Lond. *Electrician*, Vol. XXXI, March 17, 1893, p. 571.

are plotted on rectangular co-ordinates, by passing the beam reflected from one galvanometer through a lens, and receiving it upon the mirror of the second one placed at the conjugate focus so that its suspension is at right angles to that of the first. Then the spot of light reflected from the second mirror upon a screen or plate will trace the kind of curve mentioned above.

Report on Rails for Street Railways.*

BY C. LOOMIS ALLEN.

In the construction and equipment of street railways some particular specifications as to quality and finish of materials to be furnished are generally prepared. This is done for two reasons: First, to obtain materials of a certain standard and quality and prohibit makers of cheap material or poor quality from submitting bids; and second, to compare on a uniform basis the bids of different manufacturers. I may say that this is true of the construction of the power plant, car houses, repair shops, cars and their equipment, overhead material, and to a certain extent in the construction of the track. We are careful to purchase ties of certain kind, quality and size; spikes of a particular type and size, and to have joints of a specified length, thickness and weight, the rails to be of a certain section, weight and height, but as to the character and quality of the metal to be used in the rails and their appurtenances nothing generally is said. In other words, we buy our rails, taking what the rail makers give us so far as quality of material is concerned. I do not condemn the rail makers or believe that there is any intention on their part to give railway companies any material other than that which will be of good quality and finish, but when the wear of traffic shows that there are certain defects in the rail we naturally seek the cause and, if possible, the remedy. Some of our nine-inch rails after a traffic of two years have shown such signs of wear, considering the length of time they have been laid, that after investigation we have concluded that rails of a harder quality of steel would not have shown the wear of traffic to such an extent.

Rails of hard steel, the analysis of which showed a greater percentage of carbon than the standard specification of rail-steel have been advocated by some of the steam railway systems for some years, and I might add that their use has been a success in every way. The most notable instance of high carbon rails is that the New York Central Railroad, upon the Hudson River Division near Spuyten Duyvil. These rails have been subject to as heavy traffic as any rails laid on this continent. They have been under traffic for nearly six years, and up to this time I believe none have broken. When these rails were first delivered by the makers, so certain were they that the rails would become broken under traffic, that due warning was given the railroad company by the makers, that they would not be responsible for the damage which would most certainly occur from breakage. It was my good fortune early this year to consult with one of the firms of inspectors of steel in regard to the wearing quality of high carbon rails as compared with that of rails known as standard Bessemer rail-steel, and their judgment was that high carbon rails will give from 40 to 60 per cent., greater life than rails of standard Bessemer steel. When steam roads began to ask for steel rails the composition of which called for high carbon, an extra price, from $2 to $4 per ton, was asked by the rail makers, but to-day these rails are obtainable for the same price as those of standard rail-steel specifications. In Syracuse this year we are laying rails 60 feet in length, 9 inches in height, and the half groove section. Our joint is the ribbed or corrugated 12-bolt, 36-inch joint. Our contract with the rail makers calls for rails the composition of which is as follows :

Carbon from .53 to .63.
Phosphorus not to exceed .095.
Sulphur not to exceed .07.
Manganese .80 to 1.00.
Silicon .10 to .12.

We have had five miles of track of this specification, and hope this year to lay 20 miles, and we are expecting great results from these rails. I have noticed that the wear on the head of the rail by car wheels in the course of a month does not make any impression other than brightening it at this point, while in rails of standard specification I have seen under the traffic of two weeks the metal in the head of the rail roll to the outside of the head to a very perceptible degree. The fact that there is a longer life to rails of hard steel will appeal to every railway man as an economy which cannot be sacrificed.

* Paper read before the New York State Street Railway Convention.

Railway Power Stations.*

BY THOMAS HENNING.

At no time since the advent of the now ubiquitous trolley has there been more energy, ingenuity and enterprise expended upon its improvement than at present.

Of course, the commercial view is the all-important one to business men, notwithstanding which, when one follows the peregrinations of the various factors which, combined, turn the wheels of a trolley car, and observe the thousand and one loop holes by which energy is allowed to escape without performing useful work, one would imagine for a moment that one or two roads had been constructed and maintained for amusement.

Permit me to call your attention to a few of the errors made in years gone by.

The first question of vital importance presenting itself will be the site. Should an experienced man be called upon to choose a site it would cost a few dollars. For this reason inexperienced persons have at times done the work and chosen the site, for the reason that it was in the vicinity of the work to be performed, regardless of the questions pertaining to fuel and water, or they may have chosen it owing to the contiguity of one factor and disregarding the remaining factors. This is a more expensive method than paying for having the matter properly attended to.

In the construction of a plant heavy losses are frequently borne owing to misplaced material, which being lost sight of necessitate duplicate requisitions, etc. A clerical force sufficiently large to keep an accurate account of all material required, ordered, received and used, will pay a handsome profit on the outlay.

In operation we are again confronted with many wasteful outlets. The pumps may be kept in service without examination until convenience or absolute necessity compels action; the boilers with scale on one side of the tube and soot on the other; the steam pipe covering defective; the engines in service without overhauling until they quietly refuse to do further duty; the dynamo commutators rough or brushes not properly fitted to them; switches and leads of insufficient capacity, switches unclean, their faces rough and lug joints not properly made; the feeders inadequate for the work required of them; motor commutators and brushes neglected, and finally the rails not properly bonded, if bonded at all.

I have known of instances of units having been kept in service under full loads and overloads (notwithstanding the fact that there were units idle) upon the theory that the larger the output from each unit the greater the economy. I believe that this is a delusion and should be avoided. It is not economical to overload any part of the plant unless absolutely necessary.

All these weak spots waste money every minute that the system is in operation. It may be that each person concerned is so absorbed in devising new and novel means for the propulsion of cars, and for other purposes, that we forget, for a time, to make the best of our present opportunities. When a weak spot is observable in any part of the system, repairs should be begun at the earliest possible moment. If allowed to run along until necessity compels them, it will prove to be a very expensive and a very dangerous practice.

In stations of 2000 horse-power or over, it will pay to extract the oil from the wipers, which may be done by enclosing them in a tank into which a steam jet has been inserted; the oil upon rising to the top of the tank may be drawn off for purification, the wipers dried out and used again, repeating the operation until the wipers are worn out.

There is nothing connected with a power-station that will pay a larger dividend than cleanliness. If the station be kept scrupulously clean the employees will take more interest in their work, and the treasurer will not be called upon to pay for so many tools and other things lost and misplaced.

Of course, as science and capital are moving along rapidly hand in hand, we may reasonably expect in the near future to be able to eliminate some of these factors which tend to swell the cost of power. The success of long-distance transmission and the improvements quietly but continually being made in motors, dynamos, and other electrical appliances, indicate that the time is approaching when we may expect a higher efficiency in all branches of the service.

As an earnest of this, I may instance the bold but brilliant move of General Manager Littell, of the Buffalo Railway Company, in arranging to carry his patrons to divine service on Thanksgiving Day, 1896, by power generated by the waterfall of the Niagara River, over twenty miles away.

* Paper read before the New York State Street Railway Convention.

Before concluding, permit me to draw your attention to a matter which is frequently overlooked. The cost of operating a power station is frequently figured upon the basis of car miles. This is liable to be very deceptive and may militate against a well managed station, for the reason that insufficient copper, poor bonding and defective car equipments would necessarily make a bad showing for any station.

The correct method will be to note the output at the bus-bar and figure upon the basis of electrical horse-power.

The Use of Old Rails as Underground Conductors.*

BY F. O. RUSLING.

While the writer was the superintendent of the Buffalo Railway Company serious indications of electrolysis of the pipes within a half mile of the power-house made it necessary to call in expert advice to put a stop to the trouble. A careful and thorough electrical survey was made of the entire district. This was a long and difficult matter, since there were three systems of natural gas pipes, two of illuminating gas, one of water and two conduit systems.

Although the pipes were already connected to the negative bus-bar by large copper cables, it was found that these were entirely inadequate and that there were two points where the pipes at heavy load were three to five volts positive to the adjacent rails. One of these points was 1500 feet north and the other 1800 feet east of the power-house.

The expert calculated that until extensive changes could be made in rail returns, the former point would deliver about 1000 amperes and the latter about 3000. To bring this current to the dynamos with but five volts loss would need over $8000 worth of copper. While hesitating over this large expenditure, it occurred to us that there were about 300 tons of old tram rails on hand that might be used for the purpose. These were flat, centre-bearing rails, originally weighing 56 pounds to the yard, but were worn down to 50 pounds or less; they were high in carbon, hard and brittle.

The best scrap price obtainable was $8 per ton, delivered. Our expert carefully tested their conductivity with 1000 to 1500 amperes, using an instrument reading to one thousandth of a volt in order to secure accuracy. As the showing was satisfactory he persuaded us to let him try the rails on the 1500-foot length, which would require four rails in parallel to give the desired results.

As he guaranteed to bond them so as to make a continuous conductor, he was allowed to go ahead. A trench was dug between curb and sidewalk and a continuous trough of rough lumber put into it.

The rails were bolted together in pairs back to back and arranged so that the end of one rail was at the centre of its mate. The bonding was affected by scraping contact spots with a file near the end of each rail and amalgamating them with the Edison solid alloy.

A steel washer ¼ inch thick, 1 3-6 inch inside diameter and 4 inches outside, was dipped into hot insulating compound and placed against one rail so as to enclose the contact spot. The hole in the washer was then filled with the Edison Brown plastic alloy, enclosing an amalgamated steel spiral spring. The upper rail was then bolted on and the completed conductor lowered to the bottom of the trough, resting on one edge so that gravity would maintain the contacts. It will be evident that with this arrangement two of the bonds on any one rail would have to give way before the circuit could be broken; each bond was made sufficient to transmit 1500 amperes. When the second set of rails was lowered into place the trough was filled with a hot insulating compound and a cover nailed down. This compound was cheaper and better than asphaltum; it remains viscous even in cold weather and has high insulating qualities. It is a product of petroleum and distillation much lighter than asphaltum and costing about $25 a ton.

This four-rail conduit was connected up and carried at heavy load 1100 amperes, 1500 feet with a loss of but four volts. This result was so surprising that our expert suspected his instruments were wrong and sent them back to Weston for recalibration; they were returned, but proved that the measurements were correct. To appreciate the magnificent performance of these old rails and their bonds, I need only say that to give the same result it would require 3.55 square inches of copper, and 1500 feet of this would weigh 20,532 pounds and cost at 12 cents per pound $2,462.83. Our four-rail lengths weighed 50 tons and cost as scrap but $400.

The resistance of steel as compared with copper is usually considered to be between 7 to 1 and 9 to 1, but this including 50 bonds in each length was about 5.63 to 1. The tests proved that the plastic bonds actually did make an "electrically continuous rail" and after a year's service they are still maintaining their conductivity. This is more than can be said of any copper bond ever used. It will be noted that steel like this even at $30 per ton would be cheaper than copper as a conductor.

Our expert was then told to go ahead with the 14-rail conduit. As the steel was so hard and brittle, a great deal of time was required to file the contact spots and to bore holes for the bolts to hold them together, so another method was adopted. In the power house is an air compressor for cleaning out armatures and removing dust from the boiler-house walls. An iron pipe was connected from the air reservoir to the yard and a single layer of rails, bottom up, was put on each wagon. Each load was carried into the yard and the contact spots were rapidly cleaned with a reciprocating pneumatic tool, borrowed from a boiler shop. To avoid drilling the rails, pieces of ¾ inch iron about 24 inches by 8 inches were placed in the trough every 15 feet

These were bored at the ends for a pair of countersunk ¾ inch bolts, and had four contact spots cleaned with an emery wheel. On these were laid the plastic bonds and four rails side by side, with base down.

The spaces between the treads were just right for a second layer of three rails bottom side up. Then another set of bonds and an iron plate ¼ inch thick, 20 inches by 8 inches. On these more bonds, other layers of four and five rails, and finally a ¾-inch by 24-inch by 8-inch top, bolting all layers together. The sides of the trough were but ½ inch from the rails between clamps so as to save wasting insulating compound, with wider spaces to accommodate the clamps. Rail-joints were broken as before.

This construction allowed very rapid and satisfactory work compared with the first. The performance was also satisfactory, as the 14 rails transmitted 3250 amperes 1800 feet with but four volts drop; an insulated pilot wire was put down with this conduit and permanently connected with a voltmeter in the power-house. The rails used in this conduit weighed about 210 tons, which at $8 would amount to $1,680.

It would require 12.48 square inches of copper to equal the 70 square inches of steel. This copper, figured at 1000 feet by one square inch weighing 3854.2 pounds, would weigh 86,580 pounds and at 12 cents per pound would cost $10,389. The total cost of the rails and bonds for both conduits was about $3322 as against $12,852 for equivalent copper. The labor to install the copper would of course be less, but on the other hand we had the rails in stock and the only actual outlay was for labor, bonds, lumber, bolts and insulating material. I have not the details of these now at hand; my recollection is that the total expenditure did not exceed $2500, and that we thus secured results which would otherwise have cost nearly $15,000.

From my experience with copper bonds I should not advise the use of buried rails for conduits if copper is used for connections. Even when new it is impossible to get the full conductivity of the rail and the contacts get worse and worse as time passes.

The copper when covered with the damp earth will oxidize at a rate determined by the composition of the soil and the amount of current transmitted.

But following the lines indicated on our second-rail conduit, any road with a lot of old rails on hand can cut down its transmission losses at a slight cost. This subject is well worth careful consideration on the part of railway managers.

* Paper read before the New York State Street Railway Convention.

Postal Telegraph Company Extensions.

The Postal Telegraph Company has within the past few days taken over the telegraph lines of the Chesapeake, Ohio & Southwestern Railway system which were heretofore operated by the Western Union Company. The system covers 400 miles of railway and includes 1500 miles of wire and 50 offices. The Postal Telegraph Company recently came into possession of the lines of the Yazoo & Mississippi River Railroad. It is stated that the Postal Company is becoming strong by reason of its railway alliances. As the railway contracts with the Western Union expire the Postal Company comes into the field as a competitor and its success so far has attracted considerable attention.

New Generators at the Nassau Power-House.

There has recently been added to the Brooklyn Nassau Electric Railway power-house equipment a pair of new generators, which compare favorably in output with the largest hitherto installed for railway service.

These generators are direct-connected to Cooper-Corliss compound engines, having crank-discs on either side of the generator armature. The engines are controlled by the ordinary pendulum governor, which regulates both the high and low pressure cylinders.

The high-pressure cylinder has but a single wrist-plate operated by one eccentric, while the low-pressure cylinder has two wrist-plates, each having its own eccentric. The governor rods controlling the cut-off collars operate by means of two geared segments, the arrangement of which is shown in Fig. 1. This method avoids a long reach-rod to the cut-off valve stem on the head end, and the vibration and consequent irregularities of governing incident thereto. A hand-wheel adjustment varies the cut-off of one cylinder with respect to the other, and thus the work may be divided, within certain lines, between the cylinders in any desired ratio. The speed of each engine is 76 revolutions per minute and the stroke four feet. The high-pressure piston is 28 inches in diameter, while the low-pressure piston is 56 inches in diameter, and about 14 inches deep, making a massive affair. Liability to cutting has been anticipated by the builders by placing a band of phosphor bronze about the junk-ring which bears on the cylinder. Either set of wrist-plates is designed to be worked by hand if necessary, while the reach-rods can be disconnected and held thus by the throw of a lever. Means are provided for admitting steam to the low-pressure cylinder in case the high-pressure crank becomes stalled on a dead centre.

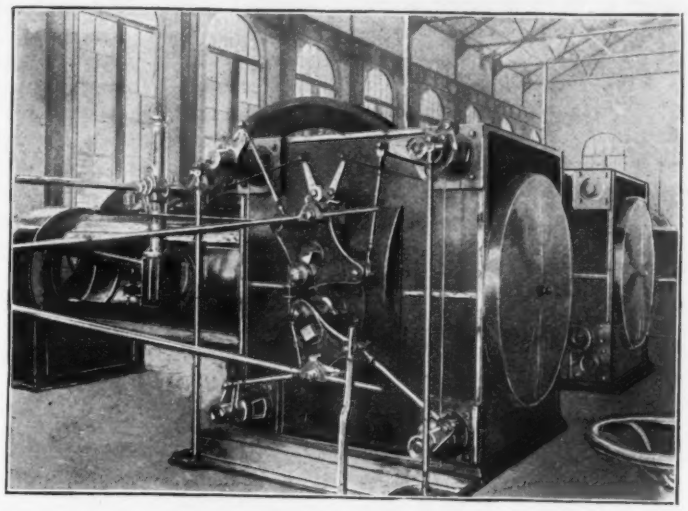


FIG. 1.

The crank-pin bearing is adjusted by two wedges which are drawn together by a screw and nut, the customary strap and half-box being used. The crank-disc is cast and counterbalanced and secured to the shaft by a heavy key. The journals are adjusted by wedges and screws, of which there are two, each having a diameter of 24 inches and a length of 36 inches. The total weight on the journals is 107 tons, or about 80 pounds to the square inch. The fly-wheel is exceptionally heavy and is cast in sections and bolted together, each section having but one spoke. On the side next to the generator is a cast-iron guard plate, placed between the bearing and the commutator.

The engine cylinders, together with the receiver used, are all steam-jacketed. The engine takes steam at 145 pounds guage-pressure and exhausts into a Worthington jet condenser, the condenser water being thrown away.

The generators are Westinghouse machines capable of supplying 2000 amperes at 560 volts. The field-frame of each is of cast iron, and is composed of two massive castings bolted together in a vertical line passing through the armature shaft. The pole-pieces are of laminated iron and are cast in one with the field-frame. No pole-shoes are used. The shunt and series coils are not wound on forms, but are strapped together with cord and tape. They are held in place on the field-poles by knobs screwed thereto, the two coils being separated from each other fully an inch. The armature is of the T-toothed ventilated type.

The winding is parallel and as there are 12 poles there are also 12 brushes. The coils are wound on the spiral and connector system. The commutator has 780 bars and is bolted to the armature spider.

The brushes are mounted on arms projecting from an iron ring which is machine fitted into the edge of the field frame. A bevel gear and worm wheel serves to manipulate this frame over the

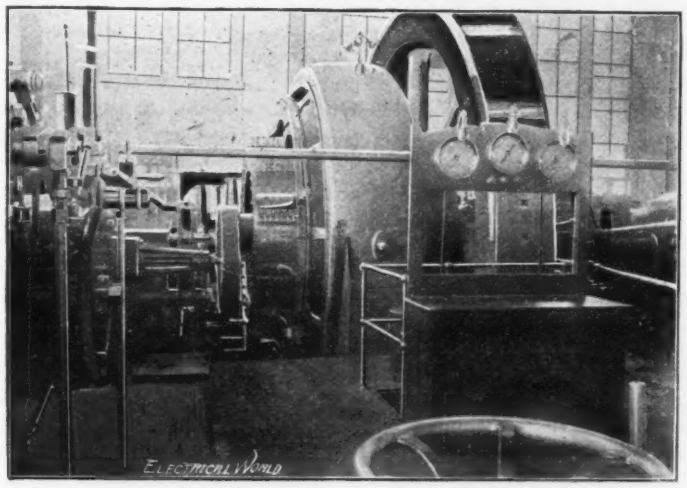


FIG. 2.

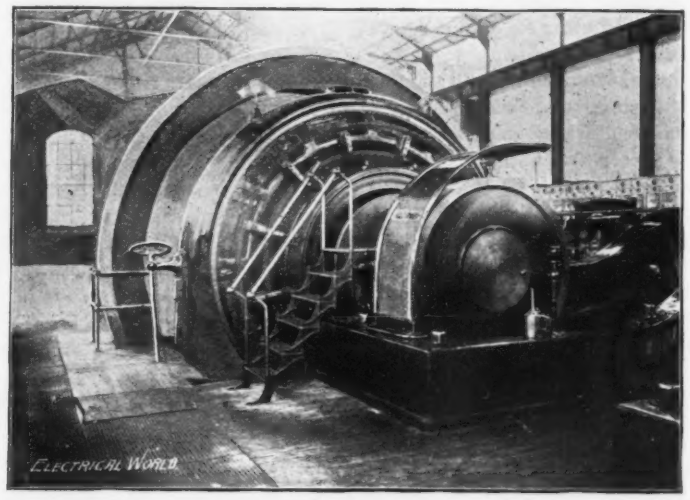


FIG. 3.

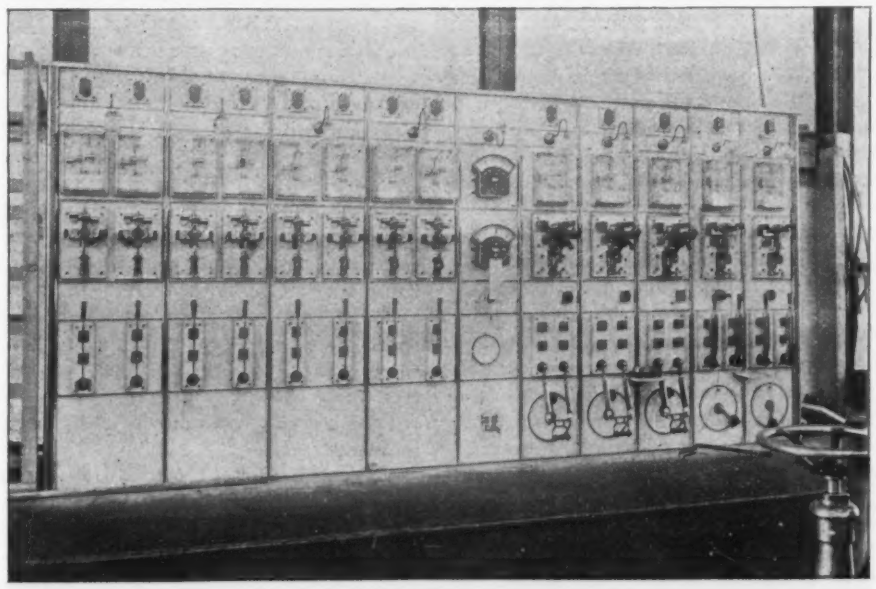


FIG. 4.

commutator. Figs. 2 and 3 show different views of those generating sets, while Fig. 4 gives an idea of the design of the switchboard.

The generators were designed to carry an enormous over-load. They were originally compounded for a 10 per cent. loss, but the fields have since been shunted in order to improve their operation in multiple with the other units. Before this was done considerable trouble was experienced, due to motoring. A unique feature in the installation of these generators is that the equalizer circuit is broken by the circuit-breaker, all of the actuating mechanism of which is located back of the switchboard.

The Efficiency of Railway Motors.

BY WM. BAXTER, JR.

The efficiency of railway motors has always been an interesting subject, but never more so than at the present time, when compressed air is making an effort to gain a foothold in the railway field. That cars can be propelled by compressed-air motors there can be no doubt, and that they will be used in places like New York, Washington, etc., is not improbable, where through unreasonable prejudice the trolley is excluded. It is safe to say, however, that they will never be adopted where they are brought into direct competition with electricity. The latter system cannot be superseded in any case where merit decides the contest, unless it be by a more efficient method of transmitting energy. Compressed air is not new and untried; it has been in use much longer than electricity, and the records of the past show that it is inferior not only in point of efficiency, but in flexibility, reliability and in every other respect that makes one system superior to another. What history has shown to be true in other fields the future will demonstrate to be equally true in relation to railway work, for there are no special conditions in this field that will tend to modify the results.

In the minds of many there are doubts as to the correctness of such conclusions, doubts that are caused mainly by a comparison of the power-consumption in trolley cars and the old horse cars, from which it is inferred that the former are very inefficient. A simple investigation of the case will show, however, that the comparison is not so very unfavorable to the trolley after all. The fact that two motors of a rated capacity of 25 horse-power are used to replace two horses of not over-robust constitution certainly does not look encouraging; but the two horses seen before the car do not represent all the energy that is used, for there are from four to eight more in the stable.

Inasmuch as it requires from six to ten horses to keep a horse car in motion, the number of hours that each pair works is so few that they can put forth an effort far beyond the normal capacity, therefore it cannot be considered unreasonable to assume that the average work each performs is equivalent to four horse-power. The average weight of the cars is about 5500 pounds while that of the passengers is over 2500 pounds, which makes the total average load about 8000 pounds. This is drawn at a speed of not over five miles per hour.

The weight of a trolley car is about 13,000 pounds, and if the average weight of passengers is taken at 3000, which is very low, the total load will be 16,000 pounds, or double that of the horse car; and as this is propelled at twice the speed the power required will be four times as much. From the above it is evident that the average power required for trolley cars should be about 16 horse-power, and this is probably somewhat above the actual amount used in practice.

Many of those who fear that electricity may not be able to maintain its supremacy, as well as those who hope that compressed air may be successful, claim that the single-reduction motors of to-day are far inferior in point of efficiency to the old double-reduction motors used in the early days of the electric railway, and that they use from 20 to 30 per cent. more current to do the same work, notwithstanding that the loss in friction of gearing is considerably less. While it is true that the modern motors take nearly as much more current as stated above, the cause thereof is not wholly the difference in efficiency; the increased speed as well as the increased weight account for a large part of the extra current.

The energy lost in accelerating the velocity of the car is by no means a small amount, and on city roads, where frequent stops are made, it may become a large percentage of the total amount of energy used. The loss from this cause is greater with high velocities than with low, owing to the fact that the rate of acceleration is greater, and the limit of velocity higher. On this account, the increase in velocity can only be effected by a more than corresponding increase in current, as in addition to the greater energy required for the higher speed a further amount must be provided to cover the extra loss due to the more rapid acceleration. By a very simple process of reasoning it can be shown that the acceleration loss is a formidable one, and that it may, in some cases, represent a large portion of the total energy used by a road. If we estimate the energy necessary to keep a car in motion at the average speed it will be an amount considerably less than the actual expenditure in practice. The discrepancy thus shown cannot be said to be due to the higher velocity at which the car runs, over some portions of the road, for the amount of energy required to move a load over a given distance is practically the same regardless of speed; hence if the car runs fast at one point and slow at another, the average power should be the same as if it moved uniformly at the average velocity; therefore the discrepancy must be accounted for in some other way, and this other way is by the amount lost in accelerating the velocity.

If we take the average power per car at 15 horse-power and the efficiency from trolley to axle at 75 per cent., we would have 11¼ horse-power to account for. Assuming the weight of car and load to be 16,000 pounds, and the tractional resistance 15 pounds per ton, which is undoubtedly high, the horizontal effort would be 120 pounds, and this at 10 miles per hour would require 3.2 horse power. This would leave about eight horse-power, which would be sufficient to overcome a grade of about 1.9 per cent. As the average gradient of the average road is undoubtedly less than one half of this, it must be very evident that not over two thirds of the power is used to overcome the tractional resistance and the grades; the balance is used to accelerate the velocity.

The foregoing, to be sure, is only a guess, but any one who is familiar with the subject will admit that it is not very far out of the way for the energy required to overcome grades cannot, on an average, amount to more than would be necessary on a continuous ascent of about ¾ per cent. In making such an estimate it must be remembered that where there are many up-grades there are a corresponding number of descents, and while no energy is recovered on the down-grade, there is quite a considerable saved. It must also be remembered that there are many roads that are almost free from grades, so that the average road would be one where the power expended in lifting the load would not be more than that represented by a continuous ascent of small percentage.

If the figures here assumed are correct, about one third of the power used to operate trolley cars is lost in accelerating the motion; but whether these figures are correct or not, the fact still remains that whatever the loss may be it cannot be modified by changing the form of energy. If compressed air cars are made of the same weight as the electric, and run at the same velocity, the energy delivered by the motors must be the same under the same conditions.

The saving of power effected by a reduction in speed of motors is very much greater than the loss in average velocity of the car, and this is especially true of city roads where frequent stops have to be made. The correctness of this statement is proved by the difference in the current consumption of the single-reduction motors of to-day and the old double-reduction type, and also the difference in the average running velocity of the two. A modern car will run on a level track, and with an average load, at a speed of 20 or 22 miles per hour, and the old double-reduction motors under the same conditions would make about 14 miles. Through the crowded streets of cities the higher speed is of little value; and this is also the case on down grades, where gravity is the impelling force. Owing to these facts the single-reduction motors of the present time cannot show much gain in running time from end to end of line. The gain certainly does not compensate for the difference in current consumption.

If the compressed air cars should be made to run at a slower speed than the present trolley cars, they will be able to make a showing in power consumption that may give them a strong foothold, but this would only be temporary, for by resorting to the same expedient the working efficiency of electric motors can be considerably increased.

No system brought forward as a competitor of electric traction can meet with success, unless it is as perfect in every detail, as free from objectional features, and as efficient in the use of energy. An electric car is provided with two motors, not because one would not answer the purpose, but because with two the reliability of the service is increased, since it would be highly improbable that both motors would become disabled at the same time. Each motor is made of sufficient capacity to run the car with a maximum load,

and therefore ready for any emergency. A compressed air car to be equal in this respect should be provided with two sets of engines. Two engines would not be equivalent to two motors, owing to the fact that one engine could not run the car up a grade, as the crank would stop on the dead centres. If a compressed air car is provided with two sets of machinery it would undoubtedly weigh more than an electric car, and on account of the extra weight would require more energy for its operation.

The inevitable losses incurred in the compressed air system are so much greater than those of the electric that the only hope for compressed air traction lies in such gain as it may be able to make in the power required to propel a car running at a lower velocity. This, however, would only be a temporary advantage because if forced by competition the electric cars could also reduce their speed. A reduction in speed has not been considered necessary up to the present time, and inasmuch as it is easier to design a fast-running single-reduction railway motor then one of a slow-speed type, designers, as a rule, have not attempted to overcome the inherent difficulties when not compelled to do so.

There are many who believe that the present railway motors are of the very highest efficiency, owing to the fact that they can make a very good showing when tested under special conditions ; and taking this view of the case, they conclude that if compressed air could show as high economy, it would at once become a rival of electricity. But the fact that a motor can show a high efficiency under special conditions does not prove that its working efficiency will be high. If it is wound for a high velocity it may give a high efficiency in a shop test but will not on the track, unless it can develop a torque sufficient to keep the car in motion. If the torque at a given speed is less than the resistance to motion of the car, the velocity will be reduced until the current is increased to a point where the resistance and torque balance each other, and at this point the efficiency may be very low. This is the case with the present motors, their efficiency being high on a level road but on grades very low. It is also low when the car is started and the speed is accelerating; lower than it would be if the motors were designed to run slower at their maximum efficiency. Under any conditions the efficiency of a motor is very low while the speed is building up, but in single-reduction motors it is more so owing to the fact that the cross-section of the field is small and the magnetizing current, long before reaching its maximum, is so great that the flux density reaches a point beyond which it cannot be pushed much further. In addition to this the armature magnetization is very strong in comparison to the field, so that when the current increases the reaction materially reduces the torque below the value which it would have if the relation between field and armature were more favorable.

If the motors were designed with a view to obtaining a higher efficiency at low velocity the starting current as well as that required on grades would be considerably reduced, and as a result the working efficiency would be increased. This can be done, and if rendered necessary by competition will be done.

Some Remarkable Electrical Applications.

The potency of the word "electricity" as a popular symbol for everything that is mysterious, new, or beyond the common ken, is well illustrated by the manner in which it is used by Summer resort fakirs. Everything done by them is "electric." All their illusions are electric. Every piece of concealed mechanism is electric. Even the influence they exert over their audience is "electric." In fact some very wonderful manifestations of the current are to be found at Summer resorts. Coney Island has been the most prolific in devices of this kind. Remarkable "X-rays" have been produced there all Summer; a "wonderful electric swing" has puzzled the sight and the sensations of all beholders; electrical pictures taken by arc concentrating lamps "in broad daylight" were numerous, while the phonograph was rendered forever inglorious by being made to reproduce the dying delirium of poor John McCullough.

A Röntgen-ray apparatus which will enable one to see through tin is remarkable. But when this same apparatus is adjusted so as to allow an audience to see through a wooden door "one inch thick," the door being at the moment of the exhibition 20 feet from the observers, we must be pardoned the pride of prior discovery. This, however, is as nothing to the wonders yet to come. The inventor of this "newest application of the cathode rays" (he is a little, unshaved gentleman, who wears a sack coat and a beaver hat) has not yet received letters patent on his contrivance, "but soon expects to." His *chef d'œuvre* is the representation of a complete bedroom the walls of which can be seen through by the audience, "and all by means of the X ray."

Asked how it was done, the "professor" said "it was all done from the side of the stage," but entreated the spectators not to come too near, or the effect would be lost. That was a "peculiarity" of the X rays. Any one who has seen the ghosts in Richard III. represented on the stage will at once understand how the effect is produced. Gauze, which appears solid when light is between it and the spectator, immediately becomes transparent when an intense light is placed on the opposite side. It is also easy enough to "see through tin" when mirrors are placed at convenient angles, so as to deflect the sight around the metal sheet.

The "wonderful electric swing" drew its current from the swollen muscles of a powerful negro. The device is old. The patient is placed in a swing which hangs from the ceiling of a room. Soon after being seated the swing apparently begins vibrating back and forth at a great rate, which becomes greater until the person swinging nearly touches the ceiling. The attendant always tells his customer that the room "appears" to be moving, and the swing to stand "still." This is, as a matter of fact, just what happens. Instead of being operated by electricity, as announced, the swing is motionless, while the room, being constructed of some light material, is swung backward and forward by means of a windlass. The affair is a slight variation from the French device of having a swing and a room suspended from an axle, on which the room could be revolved. The "wonderful electric swing," however, was well patronized by the crowd, who saw in the word "electric" visions of unaccountable things. T. W.

The St. Louis Convention.

In a circular letter just issued by Secretary T. C. Penington, of the American Street Railway Association, formal announcement is made of the St. Louis Convention next October. The papers to be read have already been announced in THE ELECTRICAL WORLD, and considerable information given regarding the exhibition of street railway supplies, which, it is thought, will be the largest ever held. The traffic associations have granted a concession in rates, namely, a fare and one third for the round trip, subject to the usual conditions. St. Louis has ample hotel accommodations, and the rates are not to be raised. The Southern Hotel will be the headquarters of the association. Other good hotels named in the circular are the Planters', St. Nicholas, Hurst's and the Lindell. A very successful meeting is looked for.

Electric Meters.

To the Editor of The Electrical World:

SIR :—I think it not unlikely that very many of your readers may have perused with more or less interest the paper on Recording Meters, which was read by Mr. James Milne, on the occasion of the Sixth Convention of the Canadian Electrical Association at Toronto.

I have myself read this paper with much interest, and I particularly appreciate and concur in the justice which Mr. Milne has meted out to the old and reliable Edison chemical meter. I cannot, however, but take exception to many of the statements which he makes in referring to certain of the mechanical meters, more particularly to the Thomson recording wattmeter.

Referring to this instrument Mr. Milne expresses some doubt as to whether it is any advantage to an illuminating company to have in service on its mains a meter which is adopted for either continuous or alternating currents of any frequency without recalibration. I believe that a careful canvassing of the stations in the United States would show that this is in reality a marked advantage to almost every meter used. There is indeed a very large number of stations in America to-day which are distributing light both by the direct and alternating system, and generally at the same potential. To such companies the advantage of a meter which can be used indiscriminately on either system is obvious.

Not a few of these stations also supply current from their alternating mains and from their direct-current mains at different periods of the day to the same users and through the same meter. This is apparently a practice which is growing in popularity, although of course only applicable when no motors are in use.

Again, very commonly, illuminating companies which are operating both systems not uncommonly have some outlying districts which they are to-day operating by reason of their distance from the centre of distribution, by means of alternating mains and sub-station transformers, but which they eventually contemplate changing over to the direct-current system so soon as the local business warrants so doing. In such cases as this there is surely a marked advantage in being able to make the change without the recalibration or alteration of the meter in any particular.

Not a few stations also have during the past two years found it advantageous to change the frequency of their system, and to such stations as these the ability to use the Thomson recording wattmeters which they already had installed, without recalibrating them for the changed frequency, has been an advantage far more real than imaginary. In doubting the advantage of the universal character of the meter therefor the paper has, I think, run counter to the general experience of meter users.

Referring to the accuracy of the Thomson recording wattmeter upon light loads, I notice that in the paper it is associated indiscriminately with a very large class of mechanical meters which are represented as failing to give accurate results on the light-load readings. An example is cited of a 500-light meter which fails to start below five lights, and complains that at this load it takes very good eyesight to note its rotation.

Witnout commenting on the fact that 1 per cent. of the meter's rated capacity is surely as low as any one could expect it to record, I would call attention to the fact that the proper speed of rotation for a meter of this capacity, if absolutely accurate, would be only about one revolution in 720 seconds with a 60-watt lamp. It is not to be wondered at therefore that the operation of the meter should seem slow to the casual observer, even though it were recording with absolute accuracy. This very feature of the meter is undoubtedly a great merit—namely, the fact that the meter is essentially a piece of low-speed apparatus, and to most of us this means without question long life ; a fact that is borne out well by the behavior of the meter.

Although I do not care to enter into a discussion of the relative accuracy of the various meters upon the market, I think it can do no harm to point out that, compared with results obtained by the larger illuminating companies, it is quite certain that the accuracy obtainable with the Thomson recording wattmeter in commercial practice far exceeds that obtainable with the old and always reliable chemical meter, which is so ably advocated, and nowhere in the load curve is the relative accuracy of the two instruments so conspicuous as at the lighter loads.

This paper goes on to state that in actual practice after a period of use it would take 12 lamps to make a 500-light meter of the Thomson recording wattmeter type record at all, and that therefore the current to at least 8 to 10 lamps has no registering effect upon the meter whatever; and upon this assumption is built up some very dreadful figures, assuming that the meter will run on this light load for three and one half hours every night for five nights in the week, and coming out at the end of the figures with a net loss, which, by an unfortunate mistake of the printer, is shown as 4½ per cent., but whicb, upon checking these figures over, we are sure must have been intended to read 3 per cent,, as it figures that way.

I agree in thinking that the case cited appears to have been an aggravated case. Commonly users of any meter whatsoever, under conditions such as those described, would have taken means to prevent the running of a small number of lights for a considerable period regularly upon a very large meter. Ordinarily, I believe we reach such difficulties as this by installing the hall and office lights of theatres, etc., on a separate small capacity meter.

It is further stated in this paper that this same percentage of error holds good on the smaller meters. I frankly agree that the percentage of accuracy in the larger meters is as good as the percentage of accuracy in the smaller ones at the same percentage of total load, but I do not think that this brings the matter out in a new and serious light by any means; for, if a 500-light meter fails to run on 10 lights, then a 100-light meter would fail to run on two lights, and while it is not my experience that the average 100-light meter will have in this manner, I nevertheless believe I am voicing the opinion of most central-station men when I say that a 100-light meter is seldom if ever installed at a point where a load as small as two lights would be placed upon it. I am forced to believe from the strong manner in which this particular characteristic of meter is brought out, and applied more particularly to the Thomson recording wattmeter, that other standard meters have not been carefully investigated with a view to obtaining data in regard to their behavior under similar conditions.

Referring to yet another factor in central-station meter operation, I quote the following: "I think I am pretty safe in stating that the motor meter has nearly outlived its usefulness as far as elevator work is concerned." This statement is based on the assumption that the recording meter in question reminds one "of a lazy man, slow to start and quick to stop."

While very reluctant to take issue on this or any other matter, I believe that I am pretty safe in stating that the one thing which the Thomson recording wattmeter will do a little better and more accurately than anything else in the way of difficult measuring, is to render a true account of the energy consumed by electric elevators. It is a fact well known to engineers that there is no more efficient means of storing power than by conserving it in a rotating disc or fly wheel. In the Thomson recording wattmeter every watt of the energy which passes through its coils plays its definite part in spinning up the shaft mechanism of the meter to a definite speed, representative of the energy applied; and from the very theory of the meter it should be obvious that the reluctance of the mechanism to start forward is almost exactly offset by the continuance of rotation after the cessation of applied energy. Since, however, experiments are commonly more convincing than theory, it may do no harm to state that I have been concerned in certain experiments to determine this particular factor in connection with the meter's behavior, and these experiments were made at a time when the meter had not reached its present perfection.

They consisted in installing two meters in multiple and in series with a third meter of the same capacity as themselves. These meters were so arranged (with a special switch) that a constant amount of energy passed through the single meter without interruption, this same energy passing through the two meters which were in multiple, sometimes half through each, sometimes all through one and sometimes all through the other, the changes in all cases being abrupt. One could scarcely conceive of a more intermittent use of current than this arrangement gave, yet the sum of the record of the two meters, which measured current alternately or in multiple, agreed within less than 2 per cent. with the indication of the third meter through which the current flowed in constant quantity and without interruption.

I trust that I may be pardoned for using so much of your valuable space, and offer as my excuse the fact that I am one of those who take a keen interest in the meter problem and who is not quite unfamiliar with the subject.

CARYL D. HASKINS.

BOSTON, MASS.

A Non-Synchronous Two-Phase Alternate-Current Motor.

Table I, which appeared in the article by Mr. Wilson under the above title and published in THE ELECTRICAL WORLD, Sept. 12, page 304, should be as follows; the corrections made, however, not altering any of the conclusions previously drawn :

TABLE I.

	No. 1 circuit.				No. 2 circuit.				No. 1 and No. 2 circuits.	
	Observed maximum. $\frac{4\pi m_1 x_1}{10}$	Observed maximum. $\frac{I_1}{10^6}$	Observed maximum. $\mathfrak{B}_1$	Characteristic curve gives $\frac{Iv_1}{10^6}$	Observed maximum. $\frac{4\pi m_2 x_2}{10}$	Observed maximum. $\frac{I_2}{10^6}$	Observed maximum. $\mathfrak{B}_2$	Characteristic curve gives $\frac{Iv_2}{10^6}$	$\frac{\frac{I_1+I_2}{2}}{10^6}$	$\frac{\frac{Iv_1+Iv_2}{2}}{10^6}$
Motor running light.....	2610	0.448	5790	0.412	3000	0.437	5640	0.466	0.442	0.439
Motor loaded.....	2790	0.430	5550	0.444	3100	0.416	5340	0.484	0.423	0.464

DIGEST OF CURRENT TECHNICAL ELECTRICAL LITERATURE

BY CARL HERING

COMPILED FROM THE PRINCIPAL FOREIGN AND AMERICAN JOURNALS.

DYNAMOS, MOTORS AND TRANSFORMERS.

The Actions in the Armatures of Three-Phase Motors. BAUCH. *Elek. Zeit.*, Aug. 27.—Some time ago he found a lack of agreement between the observed and calculated results of some formula for such motors; on looking up the theories as published by different authors he found only a single formula in common; the formula gives the power generated in the windings of the part in which current is induced—that is, in the armature or rotor, as the product of the power delivered by the ratio of the slippage to the speed; he then investigated the subject and found that the calculated values for small slippage were greater than those measured, while for great slippage they were less; he then revised the deduction of this formula and found that a distinction must be made between the two systems of winding of the three exciting coils, one being that shown in the text books and the other being that used in practice (wherein the difference lies he does not state); starting with the one used in practice, he based on it a new theory, which he gives briefly. He arrives at the conclusion that the E. M. F. induced in the rotating part is proportional to half of the primary current, multiplied by the sum of two "oscillations," the frequency and amplitude of one of which is proportional to the slippage, while the frequency of the other is equal to the sum of the number of revolutions and the frequency, while its amplitude is proportional to double the value of that sum; he calls the oscillation which is proportional to the slippage the fundamental tone, and the other the overtone; the energy lost in the copper of the rotating part is equal to the sum of the energies lost by the overtone and the fundamental tone. His final conclusion is that "in practice one cannot speak of a rotating field, even under the assumption of sine curves and an ideal distribution of the winding; besides this the armature of a three-phase motor has self-induction."

Combined Alternating and Continuous Current Dynamos. R. KENNEDY. Lond. *Elec. Rev.*, Sept. 4; a short article discussing the advantages of such a combination.—He states that the fair and only partial trial at Woolwich has given surprisingly satisfactory results, in assisting to level the load line and as a standby in emergencies; he considers it the best method which has been proposed, for employing storage in connection with alternating currents, and he thinks it will be used more and more in the course of time; he thinks it is the only remedy for many of the difficulties now met with.

Losses in Dynamos Due to the Armature Current. DETTMAR. *Elek. Zeit.*, Aug. 27.—An unfavorable reply to the criticisms of Corsepius (see *Digest*, Sept. 12), of the recent article of Bláthy, whose statements the present writer endorses, adding a brief analytical discussion.

The Best Distances Between Transformers. *L'Elec.*, Aug. 15.—A translation of the article from the German which was noticed in the *Digest*, March 21.

Synchronous Motor. OSSANA. *L'Eclairage Elec.*, Aug. 22.—A long abstract, with the illustrations, of the article noticed in the *Digest*, June 13.

LIGHTS AND LIGHTING.

Lighting by Acetylene. PELLISSIER. *L'Eclairage Elec.*, Aug. 15.—The first part of a long article describing the present state of the art and the existing and proposed apparatus.

The same journal contains abstract of papers on allied subjects read at the International Congress of Applied Chemistry; one by BULLIER, on the manufacture of carbide of calcium; another by DE BREVANS, on the preparation of the gases, and on researches made for studying the impurities contained in it; another by GIRAUD, on the analysis of acetylene.

220-Volt Lighting. *Journal of El'ty*, July.—A statement that the operation of a certain private incandescent lighting plant at Santa Monica, Cal., is "very satisfactory indeed."

POWER AND HEAT.

Electrically Driven Machine Tools for Naval Construction. Lond. *Engineering*, Sept. 4.—An illustrated description of three machines used at the Austrian arsenal at Trieste. The first is an electrically driven boring spindle which can be used on shipboard in the shaft tunnel for boring the holes in the cheese couplings, in replacing a section of a crank shaft; another is for cutting a key way, and the third for expanding boiler tubes; with the latter a man and a boy can expand 200 tubes a day.

Transmission of Power in Mines. R. KENNEDY. Lond. *Elec. Rev.*, Sept. 4; a continuation of his serial.—He describes in a somewhat elementary way the machinery for electrical transmission; it is evidently intended for non-electrical mining engineers.

Safety Device for Electric Elevators. LANGNER. *L'Ind. Elec.*, Aug. 25.—An extract with two of the illustrations of the article noticed in the *Digest*, Nov. 9, 1895, describing the device used by the Siemens & Halske Company.

Transmission Plant at Lyons. ROUTIN. *L'Eclairage Elec.*, Aug. 15.—A continuation of the long, well illustrated description of this plant, with large working drawings of parts of the plant (see *Digest*, Sept. 5).

Transmission and Distribution to Great Distances. *L'Eclairage Elec.*, Aug. 29.—An abstract of the discussion of this subject before the Geneva Congress (see *Digest*, Sept. 12).

Big Creek Power Transmission. *Jour. of El'ty*, July.—A brief, illustrated description of this plant; the available capacity of the creek at present is 2500 horse-power for eight months in the year; the head is 923 feet, for obtaining which a flume 11,125 feet long had to be constructed; the plant consists of a 46-inch Pelton wheel of 500 horse-power directly connected with two 150-kw, two-phase generators operating at 1100 volts; this is raised by transformers to 10,000 and 11,000 volts, according to the load; the entire output of the power is sold to a company in Santa Cruz; the plant is to be duplicated; there is a project to transmit the power 26 miles to San Jose.

Nevada County Power Plant. *Elec. Eng.*, Sept. 16.—A brief, illustrated description of this two-phase water power plant, containing two 340-kw generators running at 5000 volts; the transmission is to points five and nine miles distant.

Power Plant at Pelzer, N. C. *Elec. Eng.*, Sept. 16, and *West. Elec.*, Sept. 19.—A brief, illustrated description of an isolated three-phase plant at a large textile mill; there are three units of 1000 kilowatts each, and the line current is at 3300 volts; the motor equipment of the mills aggregates 2080 horse-power. Fully described in ELECTRICAL WORLD, March 14, p. 285.

Extension of the Niagara Power House. DUNLAP. *Elec. Eng.*, Sept. 16.—Turbines and generators have now been installed to the full capacity of the present wheel pit and a further extension is therefore about to be made, which will give room for seven more turbines, making 10 in all.

TRACTION.

Bamboo Trolley Mast. SCOTT system. Lond. *Elec. Rev.*, Sept. 4.—An illustrated description of a strong, light mast, which is claimed to overcome the very serious objection to the great weight of a long steel pole. A bamboo mast alone would bend too much and under continuous stress would gradually alter its shape; in the present one therefore the mast is made compound, it being slightly bent by having its ends drawn together by a tie-wire, resembling in appearance an Indian bow; the two points are braced together at their middle point. Weight for weight bamboo is 13 to 14 times as strong as steel; the complete mast weighs only about one fifth as much as the usual steel mast of the same length; these masts may be made much longer than those at present in use. The trolley wheel is supported on a simple ball-bearing, which allows it to accommodate itself to the varying radii described by the mast, and there is thus no liability to jump from the wire.

Disturbances in Telephone Circuits. WIETLISBACH. *L'Eclairage Elec.*, Aug. 29.—A reprint, apparently in full, of the long report made at the International Congress at Geneva, abstracted in the *Digest*, Sept. 5; it is followed by an abstract of the discussion.

Series-Boosters for Electric Railways. ZANDER. *Elek. Zeit.*, Aug. 27.—A short article, in which he shows the advantages of this system over others for too far distant ends of the lines; he refers to the use of a simple series machine inserted in the long-distance feeder for raising the voltage; the regulation is quite automatic, there is no sparking due to different loads and no special attendance is required; some calculations are given comparing the cost of such a system with a three-phase transmission for the distant lines.

Electric Railways in Japan. *Elec. Friend* (Japan), May.—A statement that there are 34 projected electric railways, involving a capital of over $10,000,000.

Street Railways of the United States. *Eng. News*, Sept. 17.—A brief extract from the last edition of Poor's Manual. They aggregate 15,956 miles in length, as compared with 13,176 miles last year; in five years the gain in mileage has been 6294 miles. These lines possess an equipment,

so far as the unsatisfactory statistical returns will show, of 28,154 passenger cars, 20,777 motor cars, 206 dummies and 28,621 horses. Since 1891 the number of horses in street railway service has declined 162,000, or about 80 per cent. Out of the above mileage, lines aggregating 531 miles failed to make complete returns of capitalization, etc. The 15,425.42 miles reporting show a capitalization of $828,547,285 in stock, and $525,949,928 in bonds; an average of $87,809 per mile in stock and bonds was compared with an average of $60,188 per mile for steam railways.

Lightning Express Railway Service. Behr system. *Sc. Amer.*, Sept. 19.—Some of the data of this proposed system, with an illustration of the Latrigue system in Ireland; the date regarding has already been given in these columns.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Paralleling Alternators and Three-Phase Dynamos. Michalke. *Elek. Zeit.*, Sept. 3.—A reprint with the illustrations of a recent short paper describing a system used by the Siemens & Halske Company. The main object of this is to indicate whether the machine, which is being synchronized, is running above the proper speed or below it; the usual indicators simply show that the speed is not correct, but give no indication in which direction it must be adjusted. With three-phase machines the indicator lamps are not connected between the corresponding terminals; calling the three-phase terminals of the dynamo and lines *a*, *b*, *c* and *A*, *B*, *C*, respectively, one lamp is connected between *b* and *C*, the other between *c* and *B*, the third being connected as usual between the other two corresponding terminals, *a* and *A;* the waves which are generated are shown in diagrams; the minimum voltages of the three circuits of these lamps do not occur simultaneously but in succession at equal intervals, so that the lamps are lit and extinguished in succession; if the machine is running too slowly, this succession will be in one direction and if running too fast in the other, the succession of these occurrences will therefore indicate at once whether the machine is running too slowly or too fast. It is best to place the three lamps radially behind a ground glass plate, the effect then being that of a rotation of a spot of light; the third lamp, which is connected between corresponding terminals, will indicate synchronous phases. With some changes the same system can be used for single-phase alternators (the description of this is very brief and not sufficiently clear). If instead of the lamps a three-phase motor is inserted in the same way, a torque will be generated when synchronism is not complete and its direction of rotation will indicate the direction in which adjustment is necessary. It is said that this additional synchronizing apparatus greatly facilitates paralleling; the same system can also be applied to the starting of synchronous motors, when the power for bringing them to synchronism is obtained from some outside source.

Rotterdam. Mohl. *Elek. Zeit.*, Sept. 3.—A very long, well-illustrated description of this station, in which a somewhat unusual system is used. At the distant generating station there are direct-driven, continuous-current dynamos, the current from which is sent to two sub-stations in the city, which are provided with batteries of accumulators, from which the current is distributed by the five-wire system, the transmission to these sub-stations being through the two outside wires of this five-wire system; the sub-stations contain motor-dynamos for balancing the unequal discharges on the various branches, or for taking the whole load in case of failure of the battery; there are two motor-dynamos at each sub-station; in case of failure of the battery these motor-dynamos are coupled directly with each other and are used as three-phase machines, the current from which is led through a single three-phase transformer with a ratio of one to one; the accumulator capacity of each sub-station is about 1000 ampere-hours; from one of these the current is used largely for power purposes; a complete diagram of the connections (with the exception of those with the motor-dynamos) is given.

Frankfort-on-the-Main. Elek. Zeit., Sept. 3.—An extract of some length from the first annual report giving the operating expenses and other data.

Newport Station. Lond. *Elec.*, Sept. 4.—An illustrated description of this alternating-current station, including a full-page illustration of the switchboard.

South Shields Station. Lond. *Elec. Eng.*, Sept. 4.—The beginning of an illustrated description of this alternating-current station, in which Ferranti apparatus is used; in the present portion the steam plant and the switchboard are described and illustrated.

Power and Light Stations in Switzerland. Lond. *Engineering*, Sept. 4.—A continuation (see *Digest* last week) of the brief descriptions of the stations visited by the International Congess at Geneva; it includes the plants at Aarau, Thorenberg, Rathausen, Zurich, Oerlikon Works and works on the Sihl.

Statistics of Continental Central Stations. Lond. *Elec.*, Sept. 4.—A revised abstract of the tables for some of the largest Continental stations in Europe (noticed in the *Digest*, July 18 and 25; see also Sept. 5).—In a brief editorial reference attention is called to certain points, as, for instance, the use of slow-speed direct-connected engines, instead of high-speed direct-connected, as in England, also the great use made of accumulators and the large arc lamp connection; Vienna has 7775 arcs, Hamburg 1105, Elberfeld 2540; Vienna has an annual output of 6,250,000 units, and Hamburg about half of this; the latter station also supplies current to railways, and is able to turn out a kilowatt-hour for the low figures of 2.24 cents; it is admitted that the total engineering cost of the kilowatt-hour is lower in Germany than in England.

Incandescent Lamps in Series on Alternating-Current Circuits. Lond. *Elec. Rev.*, Sept. 4.—The beginning of a translation of the article noticed in the *Digest*, Aug. 29; see also March 28.

Electric Installations on the Steamship Bouvines. L'Elec., Aug. 22 and 29.—A long, illustrated description of this equipment, a short notice of which was given in The Electrical World, Sept. 19.

Protection of High Tension Lines Against Atmospheric Discharges.—L'Eclairage Elec., Aug. 29.—An abstract of the discussion at the Geneva Congress. (See *Digest*, Sept. 12.)

Standard System of Lettering Circuits. Bates. *Elec. Eng.*, Sept. 16.—He urges the adoption of a fixed standard method for all kinds of a system, and offers a suggestion in which the first letters of the alphabet are used with plus and minus signs.

WIRES, WIRING AND CONDUITS.

Multiplex Insulators. Fischer. *Zeit. f. Elek.*, July 15.—An illustrated description of porcelain insulators which are superposed on one another, with wires between them, and with a single pin or screw in common; they are to be used where there is a multiplicity of wires and it enables these to be arranged over each other in successive layers parallel to the wall, instead of being arranged next to each other at the same distance from the wall, in which latter case they occupy much more room and are more unsightly.

Metal Poles for Overhead Lines. Pierard. *L'Eclairage Elec.*, Aug. 15.—An abstract of a paper in which he shows how to calculate the dimensions of metallic poles for overhead lines.

ELECTRO-PHYSICS AND MAGNETISM.

Magnetization and Hysteresis for Certain Kinds of Iron and Steel. Du Bois and Jones. *Elek. Zeit.*, Aug. 27 and Lond. *Elec.*, Sept. 4.—They give the results of carefully made measurements to show what has been accomplished at the present time; five soft and three hard kinds were tested, they being selected as characteristic samples; the names of the makers of the samples are given; it appears that they are all made on the Continent. For low fields up to 250 units the measurements were made with a magnetic balance and up to 15,000 units by the isthmus method of Ewing and Low, the apparatus for which is illustrated; the results are given in a table, which does not admit of being abstracted; they confirm the observations of Ewing that high permeability does not necessarily accompany small hysteresis and that these quantities are to a certain extent mutually exclusive; the processes of manufacturing iron for these two qualities are therefore becoming differentiated. The curves for the three hard samples are reproduced; from this it seems that the kinds of steel examined are inferior to the so-called Haarlem steel; one of them had the greatest hysteresis over observed, namely, 265. In conclusion they give what they call a scientific and rational process for the construction of permanent magnets; they discuss the best form to be given the magnet, deducing it from the curves; from this it appears that for bar magnets it is better to have the length not less than 30 times the diameter; they show how to proceed when absolute permanency is preferred to high magnetization; they think that various so-called secret processes for making permanent magnets depend on one or more of the methods given.

Some Abnormal Magnetic Observations in Russia. Moureaux. Lond. *Elec. Rev.*, Sept. 4.—An abstract of the data from the article noticed in the *Digest*, Aug. 1.

Photographs in the Interior of a Crookes Tube. De Metz. *L'Ind. Elec.*, Aug. 25; a reprint of an Academy note.—Comparisons were made between photographs taken in the tube and outside of it, and it was found that the lights and shadows were about in the same order in both; two tables are given showing the relative order of a number of substances in the two cases; the identity is not perfect, differing greatest in the case of lead. The question of whether cathode rays are polarized or not is briefly discussed, and it is stated that they are not. In the discussion Poincaré suggested that it is necessary, in interpreting these results, to find whether the cardboard in which the plates are wrapped does not emit X-rays, due to the impact of the cathode rays.

X-Ray Screens. Henry. Lond. *Elec.*, Sept. 4; noticed briefly from the *Comptes Rendus*, Vol. 123, No. 8.—He shows the superiority of sulphide of zinc over all other materials for such screens; the object is laid upon the screen, and after a few minutes' exposure the screen is taken into a dark room; the transparent parts come out light, and one can study the smallest details of the image for at least a quarter of an hour, or longer, if a source of dark heat is applied to the screen; the method admits of a great economy of electric energy and tubes, and is recommended for demonstration purposes; this sulphide of zinc is far more sensitive to Röntgen rays than sulphide of calcium.

Glow-Worm Radiations. Henry. Lond. *Elec.*, Sept. 4.—A short statement from *Comptes Rendus*, Vol. 123, No. 8.—He placed some glow worms for half an hour to two hours on a properly protected photographic plate, which on development showed black and white lines corresponding tolerably accurately with the subventral lights of the glow worm.

Lead or Lag. RHODES. Lond. *Elec. Rev.*, Sept. 4; a short contribution to the recent discussion of this subject.—The question was whether the displacement of phase produced by a capacity causes the current to lead before the E. M. F. or lag behind it; he gives the solution of a mathematical problem which he believes answers the question completely; from this he comes to the conclusion that if the effect of self-induction creates a lag, then capacity causes a lead; the physical nature of the phenomenon compels one to regard a lag or lead of over 180 degrees as meaningless, when the only E. M. Fs. in the circuit in addition to the impressed one are due to capacity and self-induction; in supposing that both capacity and self-induction produce a lag, he shows that it leads to an absurdity.

X-Ray Tubes. RIGHI. *L'Eclairage Elec.*, Aug. 29; an abstract of a paper from the Italian.—He has come to the conclusion that for obtaining the best results the tubes should be reduced in size; as their size is diminished the pressure may be increased, the discharge having the same character; he constructed very small tubes whose diameter was only a few millimetres, and the distance between the cathode and the anti-cathode only a few centimetres; the maximum intensity of the rays with these tubes was obtained at a pressure which was much higher than that in the ordinary pear-shaped tubes; for a tube eight mm in diameter and a distance between the electrodes of eight cm he obtained maximum intensity for a pressure of one twentieth of a millimetre, while in the large pear-shaped tubes the pressure is one fiftieth of this; the intensities were measured by the electric method. The images obtained with these tubes are very sharp and require but a short exposure; he prefers to use aluminum plates at the ends of the tube which serve at the same time as the anode and the anti-cathodic surfaces; he finds that it is not the length of the tube but the small proportions, which enables a higher pressure to be used; in the small tubes he found that for too high a pressure the effect is that no result is obtained, but at a certain pressure a maximum intensity is reached; according to his investigations the length of a tube ought to be ten times the internal diameter, as this gives the best results; such tubes can be made in a few minutes and can be exhausted in 15 minutes; a brief description of how they are made is given; with one of these tubes he obtained distinct images of the bones of the hand with a single discharge, corresponding therefore to an instantaneous photograph.

Absence of Refraction of X-Rays by Potassium. BEAULARD. *L'Ind. Elec.*, Aug. 25, and *L'Eclairage Elec.*, Aug. 29; a reprint of a short Academy paper.—With very delicate apparatus it was not possible to find any appreciable displacement of the image through a prism of potassium; if any deflection exists it is less than 10 seconds, in which case the index differs from unity by a quantity less than 0.0001.

The Dielectric in the Discharge by Röntgen Rays. PERRIN. *L'Ind. Elec.*, Aug. 25, and *L'Eclairage Elec.*, Aug. 29; translated in Lond. *Elec.*, Sept. 4.—A reprint, with illustrations, of an Academy note describing the part taken by the dielectric in the discharge caused by X-rays.

L'Ind. Elec., Aug. 25, and *L'Elec.*, Aug. 22, reprints a short Physical Society paper by the same author on this subject, together with a discussion of some length.

Action of High-Frequency Currents on Toxines. D'ARSONVAL. *L'Ind. Elec.*, Aug. 25, and *L'Elec.*, Aug. 22.—A communication to the French Physical Society replying briefly to the recent note of Marmier (see *Digest*, Aug. 29). The present writer believes that the action of the high-frequency current is not due to calorific effect; he believes it to be chiefly an electrolytic effect, not to the liberation of chemical products at the electrodes, but rather to the very rapid decomposition and combination between molecule and molecule without the appearance of any liberated product.

Wattless Currents. BLONDEL. *L'Eclairage Elec.*, Aug. 29.—A reprint, apparently in full, of the long paper read before the Geneva Congress, and abstracted in the *Digest*, Sept. 12.

Thermic Effect of Cyclic Magnetization. MEYER. *Zeit. f. Elek.*, Aug. 1 and 15.—An article of some length beginning with a general discussion of the subject of hysteresis, the discovery of which he credits to Prof. Warburg; he then gives a number of formulas for the calculation of the heat effect and shows how this may be applied to an instrument for measuring the frequency of high-frequency currents; it consists of a fine, stretched wire, like the one in the Cardew voltmeter, but of iron in the interior of the solenoid through which high-frequency currents pass; the expansion of this wire by the heat generated by the hysteresis is a measure of the frequency and is directly proportional to it; he admits that the measurements cannot give very accurate results. He also shows how the energy of hysteresis and of Foucault currents may be utilized for producing electrical heat.

Magnetization of Alloys of Iron and Antimony. WEISS. *L'Eclairage Elec.*, Aug. 15.—A continuation of his long article; the present portion contains the results in the form of tables and curves.

X-Rays in Surgery. KEEN. *Pop. Sc. Mo.*, September; a brief extract of a recent paper in the *American Journal of Medical Science*.—He shows (in the original article) some remarkably clear productions of X-ray pictures, one of which shows very beautifully all the bones of the trunk. The difficulty at present is that an exposure which is long enough to show the bones blots out the details in the soft parts; he therefore suggests the use of a number of superposed paper films; the rays will act almost equally on them all and by withdrawing them one at a time at short intervals a series of pictures of the object will be obtained, which should show all the required details.

Röntgen Rays. LODGE. *Elec. Eng.*, Sept. 16; a brief extract from an article in *Science Progress*.—He discusses the mode by which light and Röntgen rays discharge electrified bodies; he brought metallic particles or vapors near an electrified metal which was discharging under the action of the light, and concludes that the discharge is not affected by evaporation, but that the molecules which convey the charge belong to something in the gas and not to the illuminated body. The discharge of Röntgen rays is probably affected by dissociating the substances into charged atoms, which are then free to act as carriers; ultra-violet light may act in somewhat, but not in exactly the same way. He thinks everything now indicates that the rays are transverse vibrations and the wave lengths are not much greater than the size of the atoms.

Physiological Effects of Röntgen Rays. HAWKS. *Elec. Eng.*, Sept. 16.—He gives his experience briefly; besides the now well-known sunburn effect he states that the joints become nearly transparent and the nails are killed, but new ones grow; although the hair falls out it grows again, as the skin gradually returns to its healthy condition; the exposure to produce such an effect probably amounts to between two and three hours; he thinks this effect is produced by purely electrical action; the effect seemed to be confined to the skin alone and appears to consist in the drying of the oils in it. In the same issue Mr. FREI gives a somewhat similar experience, and states that a continuous application of one to two hours will start the effect.

Mercurial Pump for Röntgen-Ray Tubes. WOOD. *Elec. Rev.*, Sept. 16.—A reprint of the illustrated description noticed in the *Digest*, last week.

Powerful Lifting Magnet. West. Elec., Sept. 19.—The complete data of a magnet constructed at the University of Nebraska, including the magnetization curve and the curve showing the pull in terms of the ampere-turns; it was designed to lift 4000 pounds with a magnetizing force of 600 ampere-turns; the weight of the magnet without coil is 32.25 pounds; the coil weighs 17 ounces and contains 500 turns of No. 24 B. & S. copper wire; the weight of the keeper is 25.25 pounds.

ELECTRO-CHEMISTRY AND BATTERIES.

Electro-Deposition of Zinc. ANDREOLI. *L'Elec.*, Aug. 15; the beginning of a long article.—In the first part he discusses the relative merits of zinc plating and galvanizing, and gives a summary of the literature on the subject of zinc plating. Coles obtained brilliant deposits with a solution of 1200 grams of sulphate of zinc and 150 grams of ferric sulphate, per gallon of water; the iron salt prevents the deposit from becoming spongy; this is the process used for treating the zinc minerals at the Broken Hill Mine in Australia; free acid makes the zinc spongy; the current should be carefully adapted to the operation, and care must be taken to prevent a change in density of the bath; Coles maintained the density of the bath by keeping powdered zinc in it. The iron so plated may contain water or acid below the coating of zinc, which is the disadvantage of this process as compared with that of galvanizing. Sire and Pierson use a salt of aluminum, such as the sulphate of alum, to which oxide of zinc is added; the bath consists of one part of the oxide of zinc, 10 parts of alum and 104 parts of water; the coating is perfectly adherent and will not become detached on bending; the adherence is much better than that obtained by galvanizing, which is brittle; the adherence is increased by subsequent heating; they use a larger anode than the cathode; the electrolyte should be warm; the more concentrated the better, and it should also be as neutral as possible. By the addition of pyroligenous acid to a solution of oxide of zinc, the zinc is easily deposited in a metallic state, especially by using the tartrate; several recipes are given for cyanide solutions which are said to give good results. The article is contained in the issue of Aug. 29, in which he gives numerous formulas and the results of researches of others with special reference to those of Ruolz.

Refining Silver by Electrolysis. MOEBIUS method. Lond. *Elec. Rev.*, Sept. 4; abstracted briefly from the *Oesterr. Zeit. f. Berg. u. Huttenw.*, Vol. 44; page 30.—A brief description of this method which is used at the works of the Pennsylvania Steel Company and elsewhere; the process is said to be of interest on account of the new features which it involves. The silver is first refined to reduce the quantity of other metals present to at most 2 per cent.; it is then cast in sheets to serve as anodes; the cathodes are made of sheets of pure silver; the solution consists of nitrate of copper and silver containing 0.5 to 1 per cent. of nitric acid to prevent the decomposition of the copper; the gold, bismuth, the principal portion of the lead, and a little silver and copper, fall off from the anode; the silver is removed from the cathode mechanically by scraping; the current is 18 amperes per square foot of cathode; the silver is collected every two days and the gold once a week; the silver has a fineness of 999 to 999.5 and the gold 996 to 998; care must be taken that the amount of copper in the electrolyte does not exceed 4 to 5 per cent.

Electrolytic Production of Lithium. GUENTZ. *L'Ind. Elec.*, Aug. 25.—A brief mention of a paper read before the International Congress

of Applied Chemistry; a current of 10 amperes at 20 volts is used to electrolyze a mixture composed of equal weights of chloride of potassium and chloride of lithium, whose point of fusion is 450 degrees C.; the efficiency increases the lower the temperature.

Electrolyzer. Peyrusson. *L'Ind. Elec.*, Aug. 25; an abstract of a paper read before the International Congress of Applied Chemistry.—It is characterized by the helicoidal form of the electrodes, but the description is not quite clear; the object seems to be to have the electrolyte move through a long path, which in this case is said to be 100 times the axial length of the apparatus.

Catalytic Action of Nitrous Acid. Ihlein. *Zeit. f. Phys. Chem.*, 19, page 577; abstracted briefly in the Lond. *Elec. Rev.*, Sept. 4.—The facility of the oxidation of the hydrogen ions in the Grove cell is largely dependent on the concentration of the acid, and is increased by the addition of small quantities of the nitrous acid; the effect, however, is to lower the voltage; the potential of the nitrous acid itself is lower than that of nitric acid.

Calculation of the Conductivity of Mixtures of Electrolytes. Lond. *Elec. Rev.*, Sept. 4.—An abstract of the recent article by Macgregor, and a further paper on this subject by McIntosh (see *Digest*, June 27), the original of which appeared in the same journal, the *Transactions of the Nova Scotian Institute of Science*, Vol. 9, page 101.

Dilution Law of Electrolytes. Storch. *Zeit. f. Phys. Chem.*, 19, page 13; abstracted briefly in the Lond. *Elec. Rev.*, Sept. 4.—He gives an account of a new law for electrolytes, in the form of a mathematical equation, which he has discovered; the molecular conductivities are given in the terms of the dilution of the solution; the results agree very closely with the observed numbers; the formula does not apply to very high concentrations.

Practical Results in the Electrolysis of Chlorides. Hulin. *L'Eclairage Elec.*, Aug. 15.—An abstract of the paper noticed in the *Digest* last week; it is much briefer than the one first noticed.

International Congress of Applied Chemistry. L'Eclairage Elec., Aug. 15.—The conclusion of the report of the proceedings.

L'Elec., Sept. 5.—The beginning of an account of the proceedings of this congress, with brief abstracts of the papers, all of which have already been noticed in these columns; the present abstracts are mostly briefer than those noticed before.

UNITS, MEASUREMENTS AND INSTRUMENTS.

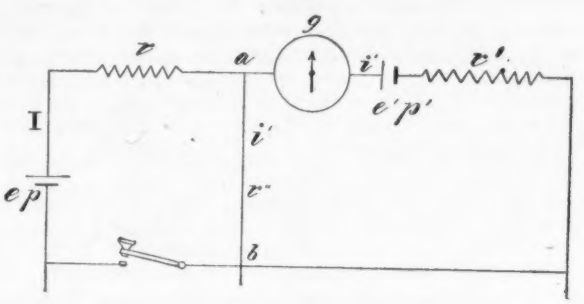
Measurement of Resistance with a Wheatstone Bridge. Dujon. *L'Elec.*, Aug. 22.—Most formulas state that to obtain the maximum sensitiveness with a given battery resistance and a galvanometer resistance, that one of these two which has the highest resistance should be placed between the two largest resistances of the bridge on the one side and the two smallest on the other; he gives several formulas as they are usually given, and states that all of these are not exact; he then endeavors to show analytically that the question is much simpler than is generally supposed; he applies the results to several methods, in one of which an E. M. F. exists in one of the branches. The latter method is applied with success to accumulators in the form of the Mance method; in the galvanometer circuit he inserts a resistance of about two or three ohms, through which a current is maintained by an auxiliary accumulator; the galvanometer circuit, including this resistance through which current is maintained, is attached to the terminals of the accumulator to be measured, as a voltmeter; the main discharge circuit of the accumulator contains an ampere-meter; the galvanometer is adjusted to give one millimetre deflection for 0.001 volt at the terminals; when the cell is discharging the current from the auxiliary accumulator is regulated so that the deflection of the galvanometer is zero; then on opening the main discharge circuit the galvanometer will read directly the difference of voltage on open and closed circuits, from which the internal resistance may then be calculated more accurately.

Wave-Form Indicator. Wittman method. *Elek. Zeit.*, Aug. 27.—A brief, illustrated description of an apparatus exhibited at the Budapest exhibition. The alternating current is sent through a very fine light coil of a d'Arsonval galvanometer, the axis of the coil being horizontal; a beam of light is thrown on the mirror connected with this coil and from there it passes to the surface of the usual rotating mirror prism, used in acoustical work, from which it is reflected on to a screen, on which it is said that a very distinct and clear image of the wave will be formed, on a very large scale.

Localization of Faults in Electric Light Mains. Raphael. Lond. *Elec.*, Sept. 4; a continuation of his long serial.—He continues the detailed descriptions of a number of methods and discusses the subject of short circuits and their localization. (As this series of articles continues to consist of detailed descriptions which do not admit of being abstracted, further installments will no longer be noticed in these columns; the whole series is to be published in book form when completed.)

Portable Ohm Meter. L'Elec., Aug. 15.—A brief, illustrated description with a diagram of the complete connections of the Chauvin and Arnoux instrument, which is a sort of Wheatstone bridge with a slide wire resistance.

A New Method for Measuring the E. M. Fs. of Batteries. Negreanu. *L'Elairage Elec.*, Aug. 15; abstracted with the illustration in the Lond. *Elec. Rev.*, Sept. 4.—Referring to the accompanying illustration, the battery to the left is the standard; the points *a* and *b* are connected through



a key; to make a measurement, adjust the resistance r and r^1 so that the deflection in the galvanometer is the same whether the points *a* and *b* are connected or not, in which case the current in that cross circuit is zero; from this he works out the ratio of the E. M. F. of the cell to be measured to the standard, and finds it equal to a fraction whose numerator is the sum of the galvanometer resistance, the resistance r^1 and the internal resistance of that cell, and the denominator is the sum of r and the resistance of the standard cell; to eliminate the internal resistances of the cells, a resistance r'' is added to r, and the resistance r' is found which when added to r^1 gives the same deflection in the galvanometer, whether the points *a* and *b* are connected or not; the ratio of the E. M. Fs. will then be equal simply to the relations of these two added the resistances, no other quantities need therefore be known.

Photometric Units. Blondel. *L'Eclairage Elec.*, Aug. 22.—A reprint, apparently in full, of his very long report to the recent international congress at Geneva; a brief abstract was published in the *Digest*, Sept. 5; besides the photometric quantities, symbols, standards and units, he discusses also at considerable length the question of heterochromic photometry; besides the propositions made to the congress he gives examples of the applications of the proposed quantities and units. This is followed by an abstract of the discussion.

Apparatus for Registering Electrical Undulations. Fradiss. *L'Elec.*, Aug. 29.—A illustrated description of the Popoff apparatus for making researches with electrical undulations and registering those produced in the atmosphere; it is based on the property discovered by Branly that metallic powders in thin layers change their resistance when a discharge occurs near them.

New Arrangement of Resistance Boxes. Benecke. *El'ty*, Sept. 16.—A description of a new method of arranging the resistances and blocks of a resistance box, so as to use the smallest number of coils, and require the smallest amount of plugging. In one of these arrangements there are four coils of 1, 1, 3 and 5 units respectively, which can be varied in steps of single units with the use of only two plugs instead of four; they are so arranged that one plug short circuits the five unit coil, while the other can be used to give any resistance from 0 to 5, and by unplugging the 5, from 5 to 10 units. In another arrangement there are six coils, five of which are unity, and the other has five units; by using only one plug the resistance can be changed from 0 to 10 in steps of single units. In the latter form, the single-unit coils are connected in series, the junctions being represented by blocks which by means of the plug can be connected to either one or two bars running the length of the box and representing the terminals of the box; the five-unit coil is connected between one of the main blocks and the end of the series of unit coils; a similar arrangement can be used for sliding contacts instead of blocks.

Substitution for Shunts and Multipliers on Wattmeters. Frankenfield. *Elec. Eng.*, Sept. 16.—Instead of shunts and multipliers for increasing the measuring capacity of wattmeters, he suggests and describes another method which seems to be to use two or more wattmeters, connecting their current coils in parallel and their pressure coils in series; this can be used with as many as three wattmeters.

Testing Department of the General Electric Company's Works. Straus. *Elec. Eng.*, Sept. 16; a continuation of his article.—Brief descriptions are given of the power plant and the testing of dynamos. To avoid the waste of power dynamos are tested in pairs by the Hopkinson method, for which only a small amount of power is required; the part of the test requiring most care is said to be to arrange the conditions suitable for starting, which conditions are described briefly; 298 instruments are in use for testing.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Protecting Microphone Batteries. Krueger. *Elek. Zeit.*, Aug. 27.—Instead of using two batteries, as suggested by Wirtz (see *Digest*, Sept. 12), he thinks it preferable to giving an audible signal whenever the telephone is laid down, instead of being hung up; for this purpose he suggests the following arrangement: The microphone battery is made to operate a vibrating bell in whose circuit are two switches, one of which is operated by the telephone hook and is closed when the telephone is hung

up, the other being a contact switch on the telephone itself, arranged in such a way that the switch is opened when the telephone is held in the hand, but is closed as soon as it is laid down or hung up; the bell will therefore ring only when the telephone is neither held in the hand nor hung on the hook. Experimental trials have given satisfactory results; it has the further advantage that the central station can hear when the telephone, when not in use, is not hung up; the call signal on the instrument could be used for this purpose.

Submarine Cable in Japan. Elec. Friend (Japan), May.—The Government has contracted for the laying of a two-core cable 18.4 knots in length, involving a cost of $15,700; it is to be imported from England.

Income from the Japanese Postal and Telegraph Department. Elec. Friend (Japan) May.—For April this was nearly half a million dollars.

Capital Invested in Telephone Exchanges in Japan. Elec. Friend, (Japan) May.—The amount allowed by the Government for the new telephone exchanges in the principal cities is about $6,400,000 "for seven years."

International Telegraph Conference at Budapest. Lond. *Elec. Rev.*, Sept. 4.—The beginning of a translation in full of the report noticed in the *Digest* last week.

Multiple Switchboard. ADHEMAR system. *L'Elec.*, Sept. 5.—The beginning of an illustrated description of the one used at the central telephone station of Bordeaux; it is equipped for 1920 double wire lines.

Kildischewsky Telephone. Elec. Eng., Sept. 16.—A quotation is given from a London paper that an electrician named Kildischewsky has discovered an improvement in the telephone by the use of which distance has no effect upon the hearing; he talked over 890 miles with perfect distinctness over an ordinary telegraph wire; he is going to London to experiment with this improvement on the Atlantic cable between London and New York. Regarding this Mr. PICKERNELL, of the American Long Distance Telephone Company, states that in this country we have a telephone circuit 1400 miles long in commercial use every day, and that he has talked over 2200 miles, which is equal to three times the distance mentioned above; he therefore sees nothing to boast of in the above dispatch; there is nothing in this account to indicate that he has anything of importance; probably it is a new transmitter; Pickernell believes that the Americans are far ahead of Europe in long distance work; the line from Boston to St. Louis, 1400 miles long, is more than twice as long as any European telephone circuit; the line to Memphis is 1588 miles. All experiments indicate that there is no possibility of ever telephoning across the Atlantic; from some calculation, which he made, the cable would have to be as thick as a hogshead; he has talked over 23 miles of submarine cable, which he thinks is about the limit of successful submarine telephony.

Mr. CARTY, of the New York Telephone Company, in the *Elec. Rev.*, Sept. 16, states that there is nothing new in telephoning over the telegraph wires; he thinks some day we will be able to telephone across the Atlantic, but at present the only successful operations of such lines are those from Liverpool to Ireland and across the British Channel, 26 miles; he believes the result will be accomplished not by improvements in the transmitter and receiver, but by improvements in the cable.

Thermostatic Fire Alarm Telegraphs. STOCKBRIDGE. *Jour. of Elty*, July.—A general discussion of thermostats, with a description of a system in which the thermostat consists of a slightly curved diaphragm; a diagram of the complete connections, with the repeater for the fire department is given.

The Telephone in Railway Operation. West. Elec., Sept. 19.—An illustrated article describing the system of the Metropolitan West Side Railway Company, in Chicago, where it has been found that the telephone is far preferable to the telegraph in operating the road.

MISCELLANEOUS.

Voltage Regulator for Thermopiles. DANNEEL. *Zeit. f. Electrochem.*, Aug. 20.—A brief, illustrated description of a simple device for regulating the consumption of gas so as to keep the voltage at the terminals of a pile constant, no matter what the cause of the change in voltage may be; one of the chief causes of alterations is the varying pressure of the gas during the day. The apparatus consists of a high-resistance solenoid through which a shunt current passes continuously; in the inside of this is a glass tube containing a permanent steel bar magnet which acts as a core of the solenoid and is suspended by a spring; at its lower end it operates a plain flap valve which limits the flow of the gas; the glass tube is sealed at the top and is connected at the lower part with the gas pipes, thus avoiding entirely the use of any stuffing boxes; there is absolutely no friction in the operation of any of the moving parts; there is a small tube shunting the valve and admitting just sufficient gas to prevent the burners from being extinguished in case the valve should be closed altogether; the error in the operation of the apparatus is made small by the use of a permanent magnet core and as many ampere windings as possible, the moving force being then proportional to the magnetism of the steel magnet multiplied by the ampere windings, while for a soft iron core it will be proportional to the number of turns multiplied by the square of the current. The results of some tests with and without the regulator are given, the former showing variations of only fractions of a per cent. while the latter show variations of several per cent.

Electrical Engineering in Japan. Elec. Friend (Japan), May.—A reprint (in Japanese characters) of the set of Government rules and regulations, dated May 5. An illustrated description is also given of the block system for railways used in that country. The issue for June states that permission has been given by the Government to use the trolley system in the City of Nagoya. It also states that the great tidal wave in the northern part of Japan, June 15, besides killing several thousand persons, "destroyed telegraph stations, with instruments, clerks, poles, lines, etc."

Death by Electricity. KRATTER. *Zeit. f. Elek.*, July 15; extracts from a recent work on this subject by that author.—It includes the results of three new series of experiments on animals; in all cases the first action was an immediate stoppage of the respiration; the action of the heart can continue for some time; whether death will ensure depends on the length of time during which respiration has been suspended; to resuscitate a subject, he should be treated as though he had been suffocated.

Exhibition in Nuremburg. Elek. Zeit., Aug. 27.—A continuation of the description of the exhibits; some portable machinery for agricultural purposes is illustrated.

Berlin Exhibition. Elek. Zeit., Sept. 3; a continuation of the description of the exhibits.—The telephone, telegraph, etc. apparatus of Mix and Genest is described.

Production of Diamonds. MOISSAN. *L' Elec.*, Aug. 15.—A reprint of the Academy note abstracted in the *Digest*, Sept. 12.

International Congress at Geneva. L'Eclairage Elec., Aug. 22 and 29.—A very long and full report of the proceedings, most of the principal papers being published apparently in full with abstracts of the discussions; all of these papers have already been noticed in these columns.

Articles on Electrical Subjects. National Recorder, Washington, Sept. 5.—This issue of this weekly journal is devoted almost entirely to electrical subjects and contains many illustrated articles of a popular nature.

New Book.

ELECTRIC LIGHTING AND POWER DISTRIBUTION; An Elementary Manual on Electrical Engineering. By W. Perren Maycock. Third edition. In two volumes. Vol. I., 415 pages. Ruled pages for notes. 231 illustrations. Whittaker & Co., 2 White Hart Street, Paternoster Square, London, and 66 Fifth Avenue, New York. Price $1.75.

Those American readers who are familiar with former editions of this work will find on persual of the contents of the present edition that it has been practically rewritten and many illustrations added. The book is designed for the use of English teachers and students as a text book, for which purpose questions have been compiled at the end of each chapter.

The author introduces his work with a discussion of elementary definitions of force, work, power, etc., and units by which they are measured.

The second chapter takes up the electrical terms, includes a table of conductors and insulators and of comparative conductance of metals and alloys.

Chapter III. treats of more extended definitions of potential, difference of potential, fall of potential and water analogues. The fourth chapter considers induction of circuits and the general laws as defined by Faraday on the inductance of circuits.

Chapter V. treats of electric bells, annunciators, indicators and kindred apparatus and various patterns, their working and maintenance.

The various magnetic properties of magnetic materials are discussed in Chapter VI., together with the terms defining each. Chapter VII. treats of electrical measurements and embraces standards of E. M. F. and resistance, construction and use of the Wheatstone bridge, potentiometers, various galvanometers, the ampere balance and Siemen's dynamometer. Chapter VIII. deals with action of the dynamo, its elementary principles and construction. Chapter IX. deals with various types of dynamos and their makers.

The book is extremely elementary in character, and will prove an aid to the student just taking up the study of electricity, although the method of treatment pursued makes it one better adapted to British readers.

Brooklyn Bridge Electric Light Plant.

The electric lighting plant recently installed on the New York terminal of the Brooklyn Bridge has several new features of interest to engineers, and is therefore worthy of description. The plant is located between the roadway and promenade and on a level with the former.

Power is supplied by two Ball & Wood engines of ample rating to furnish adequate motive power, when operated at 265 revolutions per minute, each engine being directly connected to a 50-kw C. & C. multipolar dynamo. The general appearance of this plant is shown in the ac-

companying view, Fig. 1, and conspicuous among the many points of interest is the compactness of the whole; in fact, it would be hard to imagine a more compact installation, as there is ample working room at every hand. A detailed description of the machinery employed in this installation will be of particular interest at this time, in view of the fact that both the engines and dynamos are so well established on the market as to be fairly well known by all who take interest in such matters.

In some respects the dynamos differ from the types of machines in general. The general design is that in which ring-armatures are used, the spider construction being particularly heavy. These armatures are built up of laminated soft charcoal iron and wound with rectangular ribbons. It is a noteworthy fact, however, that owing to the excellent design of the fields there is but little copper on the armatures. The field construction is unique, the magnetic circuit of which is of steel of high permeability cast in one piece, so that there are no joints in the magnetic circuit other than those of the air gap between the polar faces and the armature. Measurements taken on these particular machines demonstrated that the exciting-current required is but 50 per cent. of that usually employed for direct-connected dynamos of the sizes in question. Another point of considerable merit in this apparatus is that there is absolutely no brush movement whatever, even for load changes to 20 per cent. beyond the ratings of the machines. This result is attained by having the armature reaction and the number of poles adjusted to a point where the magnetic flux in the polar horns is not shifted from its normal position even, as before stated, to a point 20 per cent. beyond the rating of the apparatus. There are 14 poles in these machines, which guarantee a sparkless commutation within the ranges of load stated. The brushes, rocker-arms and other details are worked out to a nicety.

There has been a good deal of speculation on the part of the interested public bearing on the question of the advisability of having so many brushes on dynamos of this class, but the fact that the brushes do not have to be moved, which together with other advantageous considerations, the number of brushes employed are no detriment.

The normal capacity of these dynamos is 400 amperes of current each, at 125 volts E. M. F. They have been tested, in continuous service, at 500 amperes each, and the regular run on the Bridge makes the demand at least 325 amperes. Fig. 3 gives the mechanical dimensions of these dynamos. They furnish the current for the arc and incandescent lighting of the New York terminal, and the good effect realized speaks well for the apparatus. This plant is situated in a very conspicuous place,

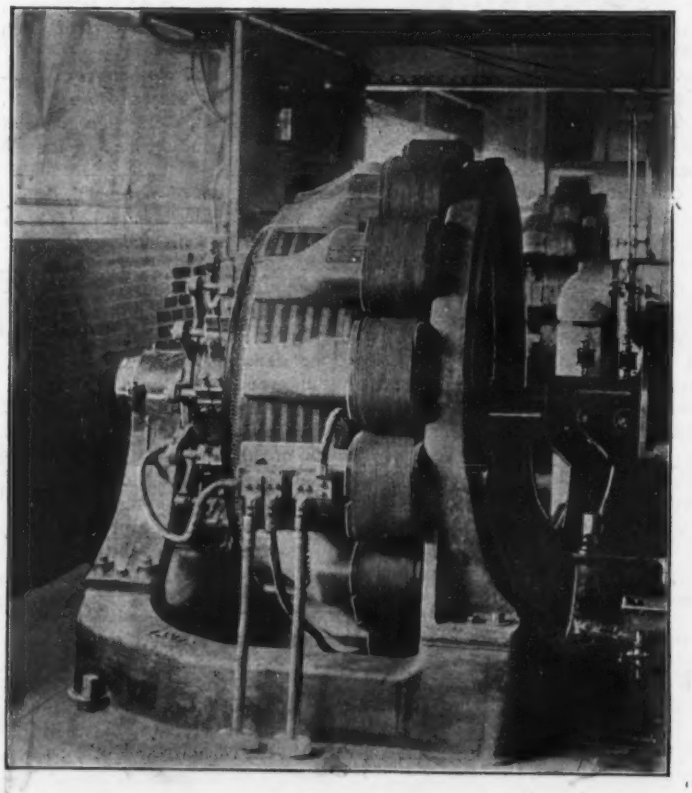


Fig. 1.

and the importance of having uninterrupted "service" can be easily imagined. The fact of the matter is, if the lights at the terminal should, from any cause, go out, there is no telling what might happen, and it speaks well for this apparatus that it has been in uninterrupted operation for some time, notwithstanding the fact that the conditions under which

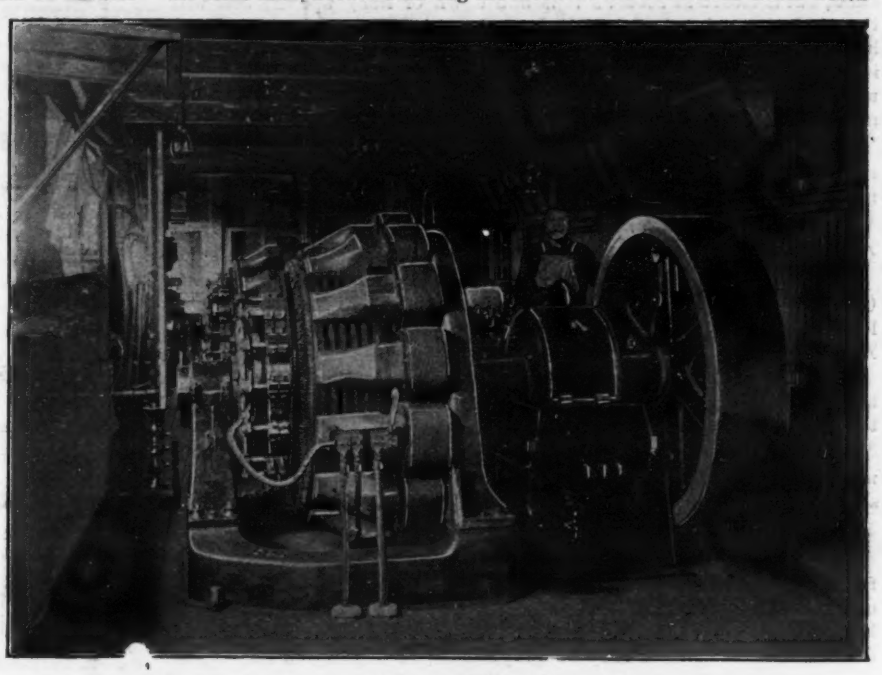


Fig. 2.

the installation was made were such that a shutdown occasionally might have been expected.

Fig. 2 gives an idea of the general arrangment of the plant. The dynamos run in multiple and are connected to the switchboard shown in Fig. 4, through three-pole switches. After a run of 10 hours at their rated load there is no part of either machine having a temperature more than

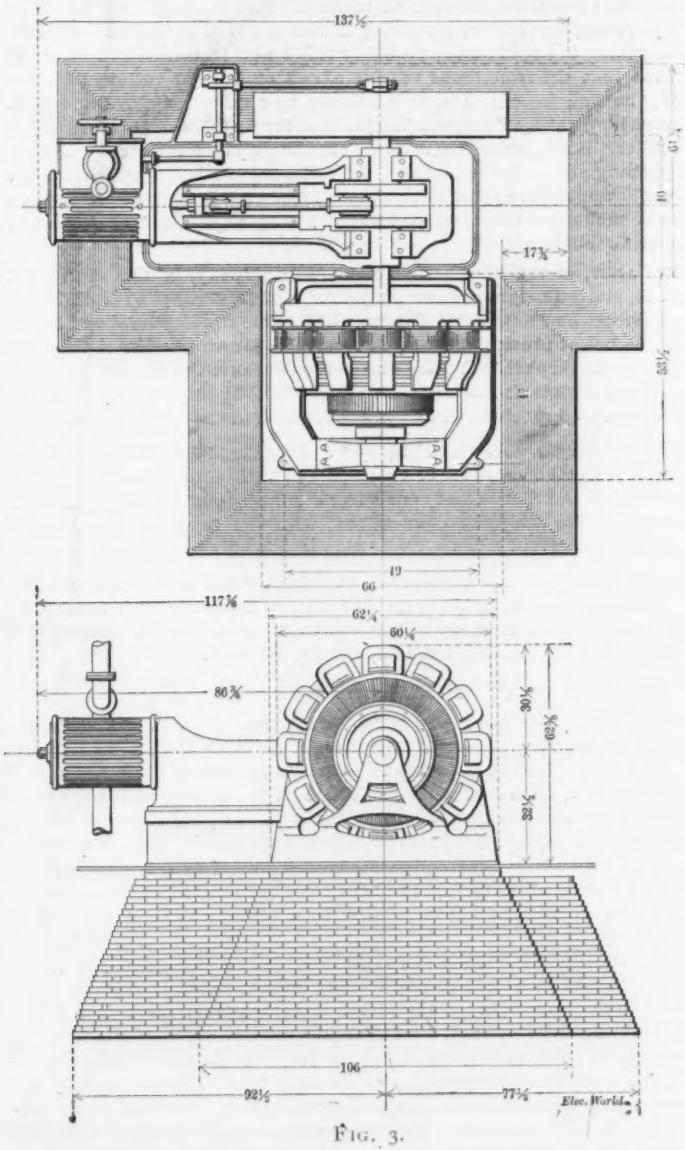


Fig. 3.

eight degrees above that of the engine room. These new multipolar C. & C. machines are apparently doing excellent service and will doubtless justify the expectations of those instrumental in their selection. One of the circuit switches carries the lights in the dynamo rooms, basements, ticket booths and similar places while the other carries the balance of

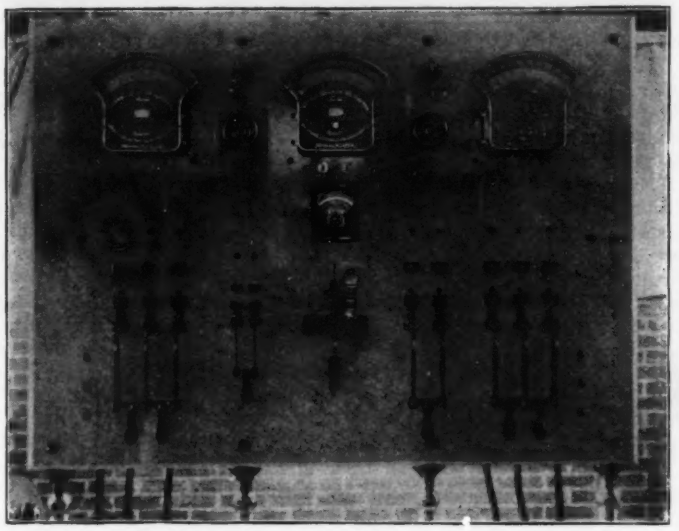


FIG. 4.

the load in the terminal station composed of both arc and incandescent lamps. The second is provided with a circuit-breaker set to open when carrying more than 500 amperes. The switchboard is provided with an ammeter for each machine, a voltmeter and a ground detector, all instruments being of the Weston make. The plant is very compactly and conveniently arranged and is a model of neatness in every respect.

The General Electric Company at the St. Louis Convention.

The General Electric Company intends to take an active part in the coming convention of the American Street Railway Association at St. Louis. It has engaged a large exhibit space in the Convention Hall, to the left of the main entrance, and will make its headquarters at the Southern Hotel.

The major part of its exhibit will be given over to the latest devices which it has developed for street railway practice, showing the advance which has been made since the convention last held at Montreal. The literature will be of the plain useful kind rather than the ornate efforts characteristic of conventions, and will contain information of value to every street railway man.

The company will be represented by a staff of its best known railway men. Its headquarters at the Southern will occupy the large parlors facing the dining-room, and here a hearty welcome will be extended to visitors.

As almost all the street-car systems in St. Louis are exclusively equipped with General Electric apparatus, the visiting delegates will be afforded an opportunity of seeing in operation much of the recent apparratus developed by the Company.

The Raworth "Universal" Engine.

This engine, which is the invention of Mr. J. Raworth, of the Brush Electrical Engineering Company, London, England, was recently subjected to a number of trials of its efficiency at the testing plant of the Brush works at Loughborough. Its performance is attracting a great deal of attention in English engineering circles, and a description of the machine will no doubt be of interest to our readers. The accompanying illustration gives a general idea of the appearance of the engine, which is directly coupled to a Mordey-Victoria alternator. The engine is said to present considerable ingenuity in its design, and the care which has been expended on its many novel details elicits favorable comment.

This engine, for the details of which we are indebted to our contemporary, the London *Electrician*, is of the vertical tandem-compound type with inverted cylinders and enclosed crank case. It is designed to run at high speeds varying from 500 revolutions in the 28-hp size to 212 revolutions in the 500-hp size, and with piston speeds varying from about 420 feet per minute up to about 600 feet per minute. Each of the tandem pistons is single acting, but as the high-pressure piston acts only on the up stroke, while the low-pressure piston acts on the down stroke, the engine in its entirety is practically double-acting. To obviate knocking on the crank-pin brasses and at the crossheads, a special form of connecting rod has been devised which possesses the additional merit of exceptionally small weight. The rod is constructed in two parts—an external frame composed of two steel ties of a fixed length being secured to the lower crank pin brass seat and the upper crosshead brass holder, while a steel strut situated between the two parts, and adjustable in length, carries the top crank pin brass and the bottom crosshead. Thus the upward thrust during the ascending stroke is taken by the ties, while the downward thrust on the descending stroke is taken by the strut, and the adjustability of this latter prevents the development of a knock by slackness at the brasses.

The engine submitted to the test on the occasion above referred to was of 45 horse-power, and when running at 450 revolutions, both full and light loads were taken without the least knock, and the engine ran throughout perfectly silent and without vibration.

At the right of the illustration is seen a column or cylinder-guard placed around the eccentric and valve rods, all of the working parts of the engine being thus enclosed. At the left of the main column is a vertical cylindrical reservoir, which is capable of holding one month's supply of cylinder lubrication. An ingenious detail of the cylinder lubricator consists of a steam-controlled oil cut-off valve, which is opened only when steam is admitted into the engine. Thus when the engine is not working the cylinder lubrication is suspended, with economical results. Within the case surrounding the eccentrics is a chain-geared oil-pump for supplying the forced lubrication of the bearings and of the brasses. This pump raises oil to the little reservoir shown at the right of the upper cylinder. From this reservoir the oil descends by gravity and is distributed to the various brasses. The crosshead pin is hollow and is designed to be perfectly tight in working and yet quite loose for removal. A very ingenious device is used for the attachment of the piston rod enabling the rod to be freely drawn out from above. The end of the piston rod is screwed and fitted with a conical nut in halves. To get the rod out it is only necessary to unscrew the top nut of the piston rod and let the rod down a few inches, when the divided conical nut falls off and the piston rod can then be drawn through.

Another interesting feature in its design is the arrangement of the piston rings. They are absent from the high-pressure piston, while the low-pressure piston is provided with only one single ventilating-ring. Steam is freely admitted at the back of this ring, which provides a tight fit on the working stroke, and during the idle stroke the relaxation of the outward pressure of the ring diminishes the piston friction. At starting there is a clear passage past the piston through the ring-groove which enables any water in the cylinder to be drained

"UNIVERSAL" ENGINE.

into the exhaust. The absence of a piston ring in the high-pressure piston is considered safe practice owing to there being no apertures or ports in the high-pressure liner. In the test, arrangements were made to take the steam consumption of a 45-I. H. P. engine at full and about half load when working non-condensing. For this purpose the engine was direct-connected to a dynamo, the circuit of which included an adjustable water resistance, and the exhaust steam from the engine was condensed in a surface condenser but without vacuum. The discharge from the condenser was collected in weighing tanks and weighed at regular intervals. The engine had a stroke of 6 inches and the cylinder diameters were 9 13-16 and 14½ inches respectively. During the entire period of testing the steam pressure at the engine stop valve was 140 pounds and the engine was maintained constantly at 450 revolutions throughout.

The length of pipe between the boiler and engine was 88 feet, of which 44 feet were covered and the other 44 feet uncovered. Under these conditions it is inferred therefore that the steam arrived rather wet at the engine stop valve and notwithstanding this unfavorable condition, the engine is stated to have made an excellent showing as was evidenced

by indicator cards and by the consumption of only 19.8 pounds of steam per I. H. P. per hour, working non-condensing.

The following is a summary of the results obtained from the test:

I. H. P.	Total steam condensed per hour.	Steam condensed per I. H. P. per hour.
43.0	852	19.8
42.2	840	19 8
44 8	888	19.8
33.5	674	20.1

Half Frosted Lamp.

The New York & Ohio Company, Warren, O., is introducing a novelty in incandescent lamps which will no doubt meet with considerable favor among users of this indispensable piece of illuminating apparatus, now so extensively used. The lower half of the bulb is frosted, and it is

Half Frosted Lamp.

claimed by the company that when treated in this manner the bulbs give out more light than the ordinary clear bulb. The volume of light, it is claimed, is increased from that given out by a plain lamp instead of being diminished as with the ordinary frosted lamp. This method of frosting is especially suitable for lamps of high candle-power, and the company is now preparing most of its 200, 300 and 500-cp Moguls in this manner.

The frosting is done by a new sand blast or frosting machine especially imported by the New York & Ohio Company from England, and the company is now making a specialty of decorated work in this line. The new frosted lamps are claimed to be far superior to the ordinary frosted lamp, and are particularly suited for use in pendants with a shade above them. The frost line is neatly scalloped and the work is accomplished in a very artistic manner. The lamps so treated give out a very beautiful soft and diffused light, the frosting being of an exceedingly fine grain.

Long-Distance Transmission Plant in Utah.

The most notable power-transmission plant yet attempted, both from the point of view of amount of power and the distance of transmission, is already under way in the State of Utah.

The Pioneer Electric Power Company, of Ogden, Utah, has within the past month placed a contract with the General Electric Company for a complete 5000-hp three-phase plant covering a transmission of 36 miles—from Ogden to Salt Lake City.

The power will be obtained from the fall in the canon of the Ogden River, at a point almost within the limits of the City of Ogden. Across the head of the Ogden canon a dam is to be thrown, and an immense storage reservoir formed, which will cover some 15 or 20 square miles of a valley in the mountains. From this dam to the power-house is a distance of nearly six miles. The water will be carried through a six-foot pipe of wood for about five miles, while for the rest of the way it will pass through a six-foot pipe of riveted steel. These pipes are fitted at intervals with automatic relief and air valves to prevent the bursting or collapsing when the flow of water is varied by changes of load. The effective head of water at the power-house will vary from 400 to 450 feet, and the full capacity of the pipe line will be 10,000 horse power.

Two duplicate receivers will be used, one at each side of the power-house, so that either can be shut down without stopping the plant. To these the pipes running to the water-wheel nozzles will be connected. The speed of the wheels will be controlled by Knight governors, and the valves will be operated by hydraulic pistons, so that the generators may be stopped and started from the switchboard. The water from the wheels on each side of the power-house will pass into a central tail-race under the floor, between the two lines of generators, and will be conveyed into canals for the irrigation of some 18,000 acres of land in the vicinity of Ogden, which will be reclaimed for farming purposes.

The electric plant at first will consist of five 1000-hp, 24-pole, three-phase generators, driven by Knight water-wheels, running at 300 revolutions per minute. The water-wheels and fittings will be furnished by the Risdon Iron & Locomotive Works, of San Francisco. Water-wheels and armature are to be mounted on the same shaft, and will be supported by the same base frame and bearings. The periodicity of the current will be 60 cycles per second, and the generators will be wound for 2300 volts.

Two exciters, each of 100-kw capacity, direct connected to their own water-wheels, will be provided, either of which will suffice to excite the fields of all the generators in the completed station.

The current from the generators will be carried by lead-covered cables, laid in ducts between the generator foundations and the wall of the building, to the generator switchboards at one end of the power-house.

The step-up transformers and the 2000 and 15,000 volt feeder-panels will be placed in a gallery erected over the generator switchboard. The transformers, nine in number, each of 250-kw capacity, will raise the generator potential from 2300 volts to 15,000 volts, at which pressure 2000 horse-power will be transmitted to Salt Lake City. The local distribution of the balance at Ogden will be made at 2300 volts.

The transmitted current will pass over six No. 1 wires, strung on insulators of a special porcelain developed by the General Electric Company to withstand high potentials, to nine 250-kw step-down transformers at Salt Lake City, which will deliver it at 2300 volts for distribution.

Electric Power Transmission in Utah.

The transmission line and transformers will be arranged to allow of the use of a potential of 25000 volts. This will permit of the efficient transmission of current to the mining regions of Mercur and other camps 30 to 35 miles beyond Salt Lake City. All lines will be protected by the latest types of General Electric lightning arresters. This plant will probably be inaugurated about the 1st of November of this year.

Renewing Burned-out Lamps.

From the time incandescent lamps came into general use the possibility of utilizing the old bulbs has been frequently discussed in electrical circles, and nearly every manufacturer has at some time attempted it with indifferent results up to the present time. Recently, however, a company has so far mastered the technical difficulties and systematized the method as to render the business commercially practicable. By the new method the collar or base end of the lamp is not disturbed, the old filament being removed and the new one placed through a small hole in the top of the lamp bulb made by removing the tip. This small hole is subsequently closed exactly in the same manner as in the case of the new lamp, leaving nothing to indicate in the finished repaired lamp that it ever had been opened.

This company—the Lynn Incandescent Lamp Company—has adopted this system of renewing lamps as its principal business, and has equipped a factory in Lynn, Mass., with special machinery for this class of work. The company is under the management of Mr. E. T. Dwyer, who is well known as a manager and through his many improvements in the manufacture of lamps, among which may be mentioned the present paste method of mounting filaments, which has been adopted by the leading manufacturers of lamps and other concerns who perform this class of work.

The invention of this paste was the first step toward rendering possible the present business of repairing lamps. Mr. Dwyer has since perfected his method in every detail, both technically and commercially, having repaired some 400,000 lamps.

It is the Lynn Incandescent Lamp Company's aim to make its repaired lamp a thoroughly high grade and standard article, and guarantee it as serviceable and economical as the best of new lamps. The filament used is of the well-known T-H-E type, which is generally regarded as the best in point of long life and maintained candle-power at a given efficiency, although it is a little more expensive to manufacture than some others.

The lamps when first received for repairs are carefully tested to select those that have failed through a faulty bulb, such as a minute fracture, etc. These are all discarded or repaired separately, and it is at once apparent that a much smaller percentage of the renewed lamps will fail a second time from a similar cause, having been thoroughly tested and become seasoned.

The filament is inserted into the bulb through the small hole at the top by a skillful twist of the hand and secured in position by the carbon paste above referred to. The black deposit on the inside of the bulb is removed by fitting the lamp to a holder and revolving it in a gas furnace, the effect of which quickly removes all trace of previous use, and then the lamp is removed with the glass as clear as crystal. Immediately following this operation a small glass tube is fused to the opening made in the bulb through which the air is drawn by a system of pumps. When the last trace of air and gas is absorbed a blow-pipe flame is directed upon the throat of the tube and melted into a point—a perfect counterpart of the tip of the original lamp. This hermetically seals the bulb, and it is then complete and ready to be measured on the photometer and tested for other qualities in the usual manner.

In repairing lamps 42 operations and 6 inspections are gone through before reaching the stage when they are ready for shipment. By this system lamps can be repaired five or six times, thus prolonging their life correspondingly. This process of effecting repairs saves nearly all of the material entering into the construction of the original lamp, and thus enables the company to make a considerable saving to the consumer.

New Small Power Motor.

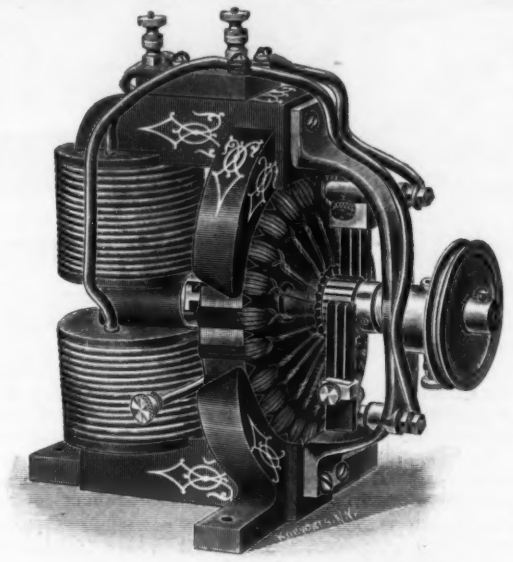
The Edison Manufacturing Company, 110 East Twenty-third Street, New York City, is one of those concerns that is constantly working in the direction of perfection in the production of its apparatus. While its products already stand high in the scale of efficiency, the company is always noting wherein improvements may be introduced for the benefit of users of its apparatus. The latter always derive the greatest advantage from these improvements, because they are enabled to operate the apparatus for less money and with greater satisfaction.

One of the first questions asked by the prospective purchaser of a motor is what it costs to run the machine, and to get this cost down as low as possible, by securing the greatest possible amount of mechanical power from a definite quantity of electric power, is the constant aim of the company.

The Edison Manufacturing Company has recently brought out a new electric motor for small power which possesses some new features of design that give the machine greater efficiency than those constructed on the old plans. In the new machine the polar armature gives way to one of the Paccinotti ring type, which greatly increases the efficiency of the machine by consuming less battery current per unit of work.

The motors are made in two sizes, No. 0 and No. 00. The former, which is the smaller of the two, is suitable for jewelers and dental lathes, where only small power is desired, and the No. 00 size is designed for heavier work, such as running sewing machines, electric pianos, railway semaphores, etc.

Both machines are wound for battery current, and are designed for



NEW MOTOR.

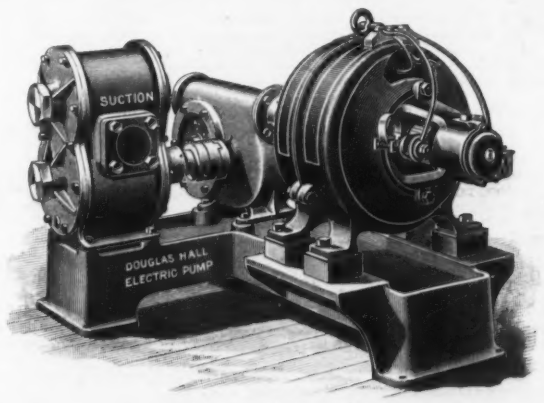
use in connection with the Edison-Lalande battery, eight cells of which supply ample power for the operations referred to.

The accompanying illustration represents the No. 00 motor. These motors are compact and carefully made.

New Electric Pump.

The electric pumping combination illustrated herewith has been designed particularly for maintaining a supply of water for house purposes, operating hydraulic elevators or for any service where it is desired to elevate or distribute water. The W. & B. Douglass Company, 67 John Street, New York, manufacturer of this pump, was among the first to adapt the pump to the electric motor, and the present combination represents the result of an extended experience in this line of work.

Any form of electric motor can be used with the pump, that shown in the illustration being of the Lundell type. To the shaft of the motor armature is direct-coupled a two-part worm, one helix being right and the other left handed; these mesh with two gears, to one of which the pump shaft makes fast. By means of this double worm-gearing, end thrust of the worm is entirely obviated. The pump is of the rotary gear type, the action being similar in principle to that of the well-known Root blower. There are two wide gears each having 12 deep teeth, the driving gear being of brass and the other of hard rubber. This, it may be remarked, is one of the oldest types of water pumps, its invention dating from the sixteenth century. In its original form a serious objection was encountered from friction and constant wear, due to the reaction of the discharge pressure. In the present type this pressure is balanced by means of ports or radial openings between each tooth and extending through the gears, the discharge pressure being thus made to act on both sides of the gears, thereby perfectly balancing them. Owing to this ingenious method, the gears are subject to no grinding wear



ELECTRIC PUMP.

against the suction side of the gear case, and the bearings will run true indefinitely.

The pumping outfit includes an automatic rheostat operated by an electrical device at the receiving water tank. This pump is the invention of Mr. M. W. Hall.

NEWS OF THE WEEK

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

NEW YORK, Sept. 19, 1896.

ELECTRICAL STOCKS.—The market was featureless during the past week, there being an absence of extraordinary influence in any direction General Electric was quiet, the price ranging between 28 (the highest) and 25¾ (the lowest), closing at 27¼. The week's transactions amounted to 10,252 shares. General Electric preferred shows a rise, Westinghouse common remains steady, while the preferred stock shows an advance of about one point.

TELEGRAPH AND TELEPHONE STOCKS generally show advances. Bell Telephone closed at a figure two points higher than the closing price the previous week. Western Union Telegraph continues the upward progress in prices, which movement began two or three weeks ago. It closed with a net gain on the week's business of 2⅝, the number of shares sold being 18,818.

TRACTIONS continue in a fair demand, the inquiry being perhaps a little firmer. The volume of trade, however, increased but little. The feature of the market was Brooklyn City Railway, which advanced about 4 points on limited trading, and very little stock was offered even at these high figures. Columbus Street Railway suffered a loss of 3 points, and Rochester Street Railway a like amount. The general tendency of prices was downward.

ELECTRICAL STOCKS.

	Par.	Bid.	Asked
Chicago Edison Company	100	..	..
Edison Electric Ill., New York	100	92	94
" " " Brooklyn	100	88	93
" " " Boston	100	..	..
" " " Philadelphia	100	..	..
Edison Ore Milling	100	7½	10
Electric Storage Co., Philadelphia	100	27¼	27¾
Electric Storage, pref	100	29	29¼
General Electric	100	27⅜	27½
General Electric, pref	100	65	..
Westinghouse Consolidated, com	50	22	24
" " pref	50	49½	50¾

BONDS.

Edison Electric Ill., New York	105	100	..
Edison Electric Light of Europe	100	75	85
General Electric Co., deb. 5s	100	85	..

TELEGRAPH AND TELEPHONE.

American Bell Telephone	100	206	206½
American District Telegraph	100	*29	39
American Telegraph & Cable	100	87	90
Central & South American Telegraph	100	124	127
Commercial Cables	100	125	..
Erie Telephone	100	56	..
New England Telephone	100	90	92
Postal Telegraph-Cable	100	77	80
Western Union Telegraph	100	81½	81¾

ELECTRIC TRACTION STOCKS.

Baltimore Traction	25	15¾	16
Brooklyn Rapid Transit		20½	21
Brooklyn Traction	100	..	14
" " pref	100	46	48
Buffalo St. Ry	100	64	66
Cleveland Electric Ry	100	..	..
Columbus St. Ry	100	40	42
Hestonville	100	46¼	46½
" pref		..	62½
New Orleans Traction	100	..	8
" " pref	100	..	60
North Shore Traction	100	21	24
" " pref	100	70	73
Rochester St. Ry	..	15	18
Steinway Ry	..	45	50
Union Railway (Huckleberry)		98	105
Union Traction, rcts $10 pd	..	12¾	13
West End, Boston	100	67	67½
" " pref	100	89	90
Worcester Traction	100	13	15
" " pref	100	83	86

BONDS.

Brooklyn Rapid Transit 5s. 1945	100	72½	..
Buffalo St. Ry. 1st con. 5s	100	101	*104
Cleveland Elec. Ry. 1st mtge 5s	100	100	*104
*Columbus St. Ry. 1st 5s	100	90	*95
Rochester St. Ry. 1st 5s	100	95	100
Union Railway (Huckleberry) 1st mtge 5s		100	*104
*Westchester Electric 1st mtge 5s	100	100	103

* With accrued interest.

DIVIDEND.—The Westinghouse Electric & Manufacturing Company has declared a quarterly dividend of 1¾ per cent. on its preferred stock, payable Oct. 1.

CHICAGO EDISON COMPANY.—It is reported that the Chicago Edison Company has sold in London $1,200,000 new 5 per cent. 30-year gold bonds. The proceeds are to be devoted to improvements.

THE BELL DIVIDEND.—The directors of the Bell Telephone Company met in Boston on Sept. 16, but took no action regarding the dividend. It is stated that no action will be taken on this subject until the return from Europe of President Hudson.

REPORTS OF EARNINGS.—The Columbus Street Railway reports gross earnings for August of $53,515, an increase of $62 as compared with the same month of last year, and net $26,782, a decrease of $2330.

The Edison Electric Illuminating Company, of New York, reports gross earnings for August of $155,016, an increase of $20,742 as compared with the same month of last year, and net $64,379, an increase of $9637. For the eight months ending Aug. 31 the gross earnings were $1,417,812, an increase of $131,897 as compared with the corresponding period of last year, and net $676,182, an increase of $71,904.

Special Correspondence.

NEW YORK NOTES.

Office of THE ELECTRICAL WORLD,
253 Broadway, NEW YORK, September 21 1896.

ANOTHER POSTPONEMENT.—The sale of the People's Traction Company's franchise, which has been pending since last October, owing to legal obstructions, has been again postponed by Comptroller Fitch until Oct. 27 next, in the hope that the court will have settled the dispute.

ELECTRICAL SUBWAYS.—The Board of Electrical Control on Sept. 16 authorized the building of electrical subways in New York City in the following named streets: Columbus Avenue, from 107th to 109th Streets; West End Avenue, from 72d to 89th Streets, and Park Avenue, from 40th to 41d Streets. These subways are to be used for electric light and telephone wires.

LARGE CONDUIT CONTRACT.—The National Conduit Manufacturing Company, *Times* Building, New York City, has contracted for 500,000 feet of cement-lined iron duct conduit to be laid in Montreal. These ducts will be used in the distribution of current from three-phase generators located at the Lachine Rapids power station. The initial pressure will be 5200 volts and this will be reduced to 110 volts for distribution in Montreal The distributing station will be in Montreal City. The plant at Lachine will develop about 14,000 horse-power. Dr. Cary T. Hutchinson of New York, is the chief consulting engineer for the Lachine Hydraulic Power & Land Company.

IMPROVED TROLLEY CARS.—The Brooklyn Heights Railway Company will add 50 new cars to its service for Fall and Winter travel. These cars embody several improvements in street car construction. The end doors so familiar to the public are being displaced by side doors, and the aisles within the cars are almost twice as wide as those in the ordinary trolley cars. Each car will have a seating capacity of 32 passengers. The old-fashioned bell and bell cord have given way to the more improved and satisfactory electric bell, and when a passenger wishes to get off the car he simply presses a push-button which rings the electric bell. The cars are equipped with Wood's safety gates. The new cars are 35 feet in length and are painted and finished in a very substantial and attractive manner.

FIRE ALARM TELEGRAPH SUPERINTENDENTS ORGANIZE.—The International Association of Police and Fire Alarm Superintendents was organized in Brooklyn on Sept. 15, and the following-named gentlemen were elected officers for the first year: President, Frank C. Mason, superintendent of the Brooklyn Police and Fire Alarm Telegraph; vice-president, Morris W. Mead, of Pittsburg; secretary, L. Lemon, of Baltimore; treasurer, Adam Bosch, of Newark, N. J.; the Executive Committee consists of John P. Barrett, Chicago; William C. Smith, New Haven, Conn.; S. L. Wheeler, Springfield' Mass; J. F. Zeluff, Paterson, N. J., and W. Y. Ellett, Elmira, N. Y. According to the constitution, the object of the association is "The acquisition of experimental, statistical and scientific knowledge relating to the construction, equipment and operation of fire and police telegraph systems and the diffusion of this knowledge among the members of the association with the view of improving the service and reducing its cost, and the establishment and maintenance of a spirit of fraternity among the members of the association." Mr Frank Woods of Bridgeport, Conn., has the honor of being the first associate member. The following-named gentlemen were also declared associate members: Capt. Willard L. Candee, George T. Manson, H. Durant Cheever, Frederick Pearce, J. W. Stover and A. B Gordon. All of these gentlemen are well known to the electrical fraternity through their connection with prominent electrical industries. The time and place for holding the next annual meeting will be decided later. After the work of the evening was concluded the party, in charge of Superintendent Mason, inspected the Twentieth Precinct station in Brooklyn and afterward made a trip around Staten Island by steamer. A trip to Rockaway was made on the 14th, where a dinner was given to the party Mr. F. C Mason being the prime mover in the affair.

NEW ENGLAND NOTES.

Branch Office of THE ELECTRICAL WORLD,
Room 91, Hathaway Building, 620 Atlantic Ave.,
BOSTON, MASS., Sept. 18, 1896.

RECEIVER.—A receiver has been appointed for the business of C. R. Reynolds & Co., dealers in electrical supplies, Hartford, Conn.

ELECTRIC MOTOR CARRIAGE THE VICTOR.—At the races of horseless carriages, which were held in connection with the Rhode Island State Fair at Providence, R. I. on September 7 and 8, the electric carriage entered by the Riker Electric Motor Company, Brooklyn, N. Y., captured the first prize by winning the races of both days. The distance was five miles, and according to the conditions of the race, the carriages were not allowed to run at a speed less than 15 miles an hour. The Riker carriage won the first day's race in 15.01¾; also the second day's race in 13.6. The fastest mile was made by the Riker machine in 2.47½. Mr. A. A. Whiting was the driver of the Riker carriage. An electric carriage was entered by the Electric Carriage & Wagon Company, Philadelphia, Pa. It came in second on the first day, and third on the second day, the time being 15.13½ and 13.33 respectively. Mr. H. G. Morris operated the carriage.

THE ARMINGTON & SIMS COMPANY.—Authoritative information has been received to the effect that the Armington & Sims Engine Company, Providence, R. I., is to continue in operation, and that the threatened suspension has been averted. The creditors' committee on Wednesday last presented its report on the condition of the company. The assets were scaled down considerably from the figures which appeared in the statement originally placed before the creditors, but even with this pruning down the condition of the company was found to be so favorable that the committee voted to continue the operation of the works. The engines contracted for will be built and delivered. The engines in process of construction, but which were being built for possible purchasers, will be completed and new orders will be placed. By careful handling of the plant the committee believes that it can bring the company out of troubled waters and into a calm sea. The engines will be improved in every possible particular, and the high standard of workmanship for which the company has become noted will be rigidly maintained. Mr. Marsden J. Perry, president of the Narragansett Electric Light Company, was selected as chairman of the Banking Committee, who voted to continue the works in operation, and will in future give the company a fair share of his attention. The company's works have never been shut down and it never made an assignment, and every bill as well as all indebtedness outside of the banks has been paid. The company has a goodly number of orders and has increased its working force.

WESTERN NOTES.

Branch Office of THE ELECTRICAL WORLD,
936 Monadnock Building,
CHICAGO, Ill., Sept. 17, 1896.

FRANK B. RAE.—This gentleman has been engaged to superintend the construction of the municipal electric lighting plant in Negaunee, Mich.

ARMORITE is forging ahead, and rapidly growing in favor for interior conduit work. The Electric Appliance Company, Chicago, is more than pleased with the success of its new specialty, and has increased the stock to supply all demands.

FIRE AT THE McGUIRE MANUFACTURING COMPANY'S PLANT.—Early in the morning of Sept. 10, the plant of the McGuire Manufacturing Company on North Sangamon Street, Chicago, was destroyed by fire. The building was 300 feet by 100 feet in dimensions, and the interior and contents were completely destroyed. The loss on stock and building is estimated at $30,000, and is fully covered by insurance.

IN FINANCIAL DIFFICULTIES.—A dispatch from Youngstown, O., states that creditors have taken possession of the Orient Electric Company and the New York Electric Company of that place. Both concerns have been engaged for the past three years in the manufacture of electric light supplies, and are controlled by Youngstown capitalists. The reason given for the action of the creditors is stated to be the failure of the companies to pay loans, and the business of the two companies will be disposed of at public sale. It is likely that the plants will be bid in, reorganized and consolidated under one management.

ELECTRIC LIGHT BIDS IN COLUMBUS.—The following bids were made on Sept. 10 for electric street lights in Columbus, O., part of the system to be underground: Edison Electric Light Company, underground, five years, $73 per lamp per year for all dark hours, and $97.50 for all-night lighting. No bid for overhead lighting. Columbus Electric Light & Power Company, underground, five years, $89 per lamp a year for all dark hours; $109.75 for all night lighting. Overhead system, $74.50 for all dark hours; $92.75 for all-night. Citizens' Light, Heat & Power Company, underground, five years, $105 for all dark hours per lamp per year; $127.75 for all night. Overhead, $82.85 for all dark hours; $99.75 for all night.

THE CHICAGO FUSE-WIRE & MANUFACTURING COMPANY, 153 Lake Street, Chicago, has purchased from the Independent Electric Company the business of its fuse-wire department and will manufacture and sell this line of tested fuse-wire. The well-known trade-mark of a spool of the product having the word "Tested" thereon also becomes the property of the new company. Mr. W. R. Goodman, who has been in charge of this department for the past seven or eight years, has assumed the management of the new company. This fact will be a sufficient guarantee that the present high character of the goods will be maintained. The Fuse-Wire Company is now completing a series of exhaustive tests and experiments which will bring its fuse-wire and links fully up to all modern requirements.

COMPLETE LIGHTING PLANT.—One of the most unique buildings in Chicago will be the banking house now being constructed for the Illinois Trust & Savings Bank. In this city of wonderful sky scrapers, this building will nestle down with only two stories to its foundation, as the owners have determined to restrict the edifice to the sole use of the bank. Mr. D. H. Burnham is the architect, and it is safe to say that no financial institution in the world will have a building more perfectly appointed for their special needs or more beautiful in artistic design and proportion. The Central Electric Company advises us that the building will have one of the most complete electric lighting plants in the city. All the wire will be inducted through iron armored conduit. The Central Electric Company thinks that there is a decided improvement in feeling among the trade. Buying is freer and the general indication is such as to warrant hopes for a reasonably good Fall trade.

CANADIAN NOTES.

MONTREAL, CAN., Sept. 18, 1896.

AMHURSTBURG, ONT.—The Amhurstburg Electric Light, Heat & Power Company (Ltd.) applies for incorporation; capital, $20,000. The applicants are Messrs. W. H. McEvoy, Amhurstburg; F. C. Armstrong, Toronto; J. J. Ashworth, Toronto; Mary A. McEvoy, Amhurstburg, and Mary A. Kane, Amhurstburg.

THE CONTRACT FOR THE CONCRETE DAM, power-house and rock excavation in connection with the Chambly Water Power Company has been awarded to Messrs. Peter Lyall & Sons. There were eight or nine tenders, and the majority of them came from the Western States. The Messrs. Lyall's contract embraces from $300,000 to $400,000, and will be begun immediately and carried on all Winter, the entire work to be completed by October, 1897.

QUEBEC, QUE.—A company of Quebec capitalists is in the process of formation to take over the franchise of Mr. Beemer and construct the electric railway. The capital necessary for this purpose for the equipment of the road is estimated by Mr. Badger, who has charge of obtaining subscriptions, at $400,000. It is the intention of the promotors to put between 400 and 500 men at work at once to equip and put in operation the Lower Town section as far as the St. Valier tollgate this Fall, and to keep the cars running during the Winter. The line from Champlain Street along Dalhousie Street is the section of the Quebec Street Railway which will be first constructed. The rails are now on their way to Canada.

MONTREAL, QUE.—The Lachine Rapids Hydraulic & Power Company has closed an important contract with the National Underground Cable Company of New York, by which the latter agrees to lay 507,000 lineal feet of concrete-lined iron duct, the contract price being about $150,000. Apart from this the company has given out contracts valued at $1,500,000, and Messrs. J. B. St. Louis and Shearer have begun the erection of a pressed-brick receiving station at the corner of Seminary and McCord Streets. From the Rapids to the receiving house just referred to, wires will be strung on steel poles, while in some streets, where the underground line is laid, no less than 66 pipes will be brought into use, and at other places there will only be four. The contract stipulates that the asphalt must be relaid in a perfect condition.

General News.

NEW INCORPORATIONS.

THE DUNMORE ELECTRIC LIGHT, HEAT & POWER COMPANY, Dunmore, Pa., has been organized with a capital stock of $30,000.

THE MUTUAL ELECTRIC LIGHT COMPANY has been organized in San Antonio, Tex., with a capital stock of $50,000. The incorporators are J. F. Green, F. A. Piper and W. W. King.

THE NEW YORK CHEMICAL & ELECTRIC COMPANY, New York, has been formed by J. H. Mason, W. A. Montignani, Edward C. Reiss and Charles H. Ridgway. Capital stock, $50,000.

THE DOW PORTABLE ELECTRIC ASSISTANT COMPANY has been organized at West Brook, Me., with a capital stock of $100,000. The incorporators are president, George W. Wheeler; treasurer, W. E. Dow; clerk, William Lyons.

THE SOUTHERN ELECTRIC COMPANY, Baltimore, Md., has been incorporated by Alfred A. Glazier, Boston, Mass.; Paul Winsor, James F. Morrison, John S. Boyd and Herbert R. Preston, of Baltimore, with a capital stock of $70,000.

THE MARIPOSA ELECTRIC POWER COMPANY, San Francisco, Cal., has been incorporated with a capital stock of $1,000,000. The promoters are C. F. Lindner, Oakland, Cal.; George E. Ecker, W. B. Taylor, Herald C. Ward, San Francisco, Cal.

THE IOWA TELEPHONE COMPANY, Davenport, Ia., has filed articles of incorporation. Capital stock, $1,000,000. The incorporators are A. Burt, C. E. Yost, G. W. Cable, F. H. Griggs, A. F. Cutter, Joseph R. Lane, A. Burdick, E. E. Cook and E. S. Carl.

THE MONTEREY COMPANY, Pittsburg, Pa., has been incorporated in West Virginia for the purpose of supplying electric light, heat and power. Those interested in the new company are George E. Shaw, Aaron French, D. C. Noble and P. H. French, Pittsburg, Pa. Capital stock, minimum, $5000; maximum, $2,000,000.

THE PERFECTION CLOTH-CUTTER MANUFACTURING COMPANY, Cincinnati, O., has been formed for the purpose of manufacturing, selling and leasing cloth-cutters and other electrical and mechanical apparatus, tools and machinery. The incorporators are Frank H. Caldwell, Harvey Palmer, J. H. Bromwell, W. E. Caldwell and John E. Bruce. Capital stock, $500.

THE RICHMOND BOROUGH ELECTRIC COMPANY has been incorporated at St. George, S. I., N. Y., with a capital stock of $400,000. The directors are William A. Clark, Jr., and W. L. Douglas, of Boston; I. J. Whipple, of Brockton, and W. L. Litchfield, of Lynn, Mass. Henry Dun Wiman and Daniel Campbell, of Staten Island. The purpose of the company is to conduct an electric light and power business on Staten Island.

Telegraph and Telephone.

DARDENELLE, ARK.—Messrs. Crownover & Hayden, of Dardenelle, purpose to extend their telephone system to Ola, in the near future.

SAN JOSE, CAL.—The People's Telephone & Telegraph Company has been attached by the Santa Clara Valley Mill & Lumber Company for $3,632.

ELKHART, IND.—The Elkhart Telephone Company will extend its lines to connect Plymouth, La Porte, Niles and Elkhart with South Bend, using metallic circuits.

SHERIDAN, MO.—A company has been organized to build a telephone line from this place to Maryville by way of Parnell, Ravenwood, Clyde and Bedison, and will also include other points.

BROOKFIELD, MO.—Steps are being taken for the establishing of a telephone system in this place. Mr. H. Reinheimer, of Shelbyville, has been granted a 25-year franchise on condition that the work begin within six months. The rates are to be $1.50 per month for residences and $2 for business houses, and the city will receive 2 per cent. of the gross earnings.

WILKESBARRE, PA.—The People's Traction Company has asked the city for a franchise to construct and operate a telephone line in this city, the wires to be laid underground, and the charges not to exceed $3.50 a month for business houses, and $2.50 for private residences. The city will be given 11 free telephones. The work is to be commenced on or before May 1, 1897, and the service to be in operation by April 1, 1898. The ordinance is now pending the second reading.

ROCK ISLAND, ILL.—The Iowa Union Telephone Company is to be reorganized, and the territory of the Central Union Telephone Company will incidentally be re-districted. The new company will be known as the Iowa Telephone Company and will, through the re-districting of the territory, acquire, in addition to its former territory, Davenport and five other Iowa cities. According to the agreement entered into between those interested in the reorganization, the business of the three cities—Rock Island, Moline and Davenport—will be carried on as heretofore. The Iowa Telephone Company by this deal is given exclusive control of the telephone business in Iowa.

Electric Light and Power.

DES MOINES, IA.—Bicycle racing was conducted by electric light on the night of Sept. 8, at the Y. M. C. A. Park. The track, which is one third of a mile around, was illuminated by means of 100 arc lights, and it is stated that as fast time was made as could have been made by daylight.

BUFFALO, N. Y.—The Board of Public Works reported that the lowest proposal submitted for installing an electric light plant at the water-works pumping station was double the amount of the available appropriation for the work. Request was made for authority to readvertise for proposals.

GENEVA, ILL.—The committee on alms and court houses of the Board of Supervisors met at Geneva and decided to recommend the purchase of an electric lighting and power plant for use at the alms and court houses. It is estimated that a plant can be put in for $4,000, to furnish light for both houses and jail.

OWOSSO, MICH.—It is stated that the Caledonia Electric Light & Power Company has absorbed the Owosso Electric Light Company, and that the present station will be enlarged by the addition of a two-story brick building. These improvements, it is stated, will give Owosso the most complete electric light plant of any city of its size in the State.

FAIRBURY, ILL.—The City Council has granted a franchise to the Fairbury Electric Light, Heat & Power Company for the use of the streets, alleys and public grounds for the purpose of installing an electric light plant. In consideration of the franchise the company will furnish free of charge to the city 12 lights for the City Hall and other lights for the water works.

LINCOLN, ILL.—Judgment has been entered against the Lincoln Water, Light & Power Company for $21,000. The plants of the company, it is stated, are valued at $450,000, and are carrying a bonded indebtedness of $210,000 and a floating indebtedness of $50,000. The embarrassment was caused by the scarcity of money and inability to procure loans. The gas plant was surrendered to Judge Foley to secure a claim of $40,000.

HARTFORD, CONN.—A queer experience occurred at the station of the Hartford Electric Light Company a few nights ago. An eel made a journey through the water pipe and got stuck in the water-meter. The obstruction prevented water from reaching the boilers, and the result was the dynamos were stopped and a portion of the city and private lighting was cut off for about an hour. This happened at about 8 o'clock at night. The eel was about 2 feet long and 1½ inches in diameter.

GREENCASTLE, IND.—At a meeting of the Council Mr. Milner presented a resolution whereas the contract for lighting the city will expire during the year 1897, and as numerous towns and cities in Indiana owned their own electric light plants, that the Mayor appoint a committee of three members of the Council to investigate the subject of municipal ownership of electric plants. Messrs. Miller, Perkins and Walls were appointed by the Mayor, and the city engineer was made an advisory member of the committee.

CHIPPEWA FALLS, WIS.—The Chippewa Falls Water Works & Lighting Company has closed a contract with the Chippewa Lumber & Boom Company, by which the latter will furnish the lighting company with 500 horse water power. This power will be used for the generation of current for power, lighting and street-car work. The Water Works Company will erect new power-houses, and it is stated that the company will have the best equipped electric power-station in the State. The electric railway which will be operated by this power runs between this city and Eau Claire.

HAZELTON, PA.—It is stated that the Lehigh Coal & Navigation Company is considering the advisability of introducing electric power for the propulsion of its canal boats. Prof. Thorpe, of Philadelphia, has submitted figures to the directors showing the cost for such an equipment. The Lehigh and Schuykill canals, the Professor says, are well adapted for the system. His suggestions are to use the falls and dams along the canals for generating the power, and to locate dynamos at such places. It is stated that the cost of operating on the electric system would be considerably less than that of the animal power which is now used.

The Electric Railway.

CLEVELAND, O.—Work on the construction of the Cleveland & Lorain Electric Railway will be started at once.

McKEESPORT, PA.—The Homestead & Highland Electric Railway is preparing to extend its lines to McKeesport.

SCRANTON, PA.—Important additions to the street railway system are contemplated by the Scranton Traction Company.

COHOES, N. Y.—The work of connecting the Cohoes City and Troy City railroads will be commenced in the near future.

WILLIAMSPORT, PA.—There is talk of a trolley line being built between this city and Montoursville by Philadelphia capitalists.

PLAINFIELD, N. J.—H. C. Smith, the civil engineer, has just completed a survey for a new trolley route to the Mountain Park Inn.

ROCKFORD, ILL.—At a meeting of the City Council Mayor Brown vetoed the franchise given to the Rockford Traction Company on Seventh Street.

NAPA, CAL.—N. W. Griswold and J. F. Byxbee will apply to the Napa County Board of Supervisors at the next meeting, for a franchise to build and operate an electric railway throughout the county.

BAYSIDE, L. I., N. Y.—It is reported in Bayside that negotiations have been concluded with the Steinway Electric Railway Company, by which its system, which at present terminates at Flushing, will be extended to Bayside.

TORONTO, ONT.—The Mayor will shortly lay before the Council a message favoring the construction of an extension of the street railway system to the island by way of the Queen's Wharf and the sand bar, by means of a bridge.

OLEAN, N. Y.—A project is on foot to build an electric railway between this place and Bradford, Pa. The Bradford citizens state that they will build the line as far as Rock City if the citizens of Olean will continue the road the rest of the way.

WINDSOR, CONN.—It is stated that several capitalists of New York and Philadelphia are considering a project to construct an electric railway from Springfield to Hartford. An engineer has already overlooked the ground with a view of locating a route.

MADISON, WIS.—A movement is on foot on the part of the Madison Street Railway Company to install an electric plant for generating power to its line. It is said that the cost of such a plant would be about $25,000. Major W. F. W. Oakley is receiver of the company.

WALKERTON, ONT.—Mr. A. Brunel, engineer of the Huron & Ontario Electric Railway, has presented his report on the route. A number of waterfalls are to be utilized for power purposes, and several bridges will be erected over the Saugeon and other streams.

BRISTOL, R. I.—A special town meeting is called for Sept. 26 to act upon the petition of the Bristol Land & Investment Company to use certain streets of the town for an electric road, to run from the depot to Mount Hope, and to the northward along Metacom Avenue to Walnut Street.

MONACA, PA.—Messrs. H. P. Brown, H. M. Camp, T. H. Javens and J. J. Hoffman, representing the incorporators of the South Side Street Railway, appeared before the Council of Monaca, praying for the passage of an ordinance allowing their street railway to pass through the borough.

Personal Notes.

MR. ERNEST H. HEINRICHS, advertising manager of the Westinghouse Electric & Manufacturing Company, Pittsburg, Pa., is the author of the novel *Helene*, recently published. If Mr. Heinrichs is as proficient a novelist as he is an advertising expert and journalist, *Helene* will be a popular name from this time on. The electrical fraternity, we feel sure, join us in wishing Mr Heinrichs and *Helene* every success.

MR. MAX OSTERBERG, formerly editor of *Electric Power*, has opened an engineering office in the Thames Building, Thames Street, New York City. Mr Osterberg's technical knowledge, combined with practical experience, should secure him a large practice. His specialty is small electric railways with gas engines as the prime movers. There is a field for such roads in the suburbs, and many men, whose means fall within the thousands rather than the millions, are anxious to invest their money in just such enterprises. Mr. Osterberg is prepared to promote and engineer such undertakings to a successful issue. He is also prepared to engage in any practice such as would fall within the scope of an accomplished electrical engineer.

Obituary Note.

CHARLES L. CHAPIN, who it is stated was the oldest telegrapher in the country, died in Philadelphia on Sept. 14, at the age of 66 years. Mr. Chapin was in telegraph service continuously for 50 years, beginning as an operator at the age of 16. In 1846 he was operator at the Coney Island end of the second line built between the island and Brooklyn for the maritime service. Mr. Chapin learned telegraphy from a copy of the Morse alphabet presented to him by Professor Morse himself. In 1850, when Ezra Cornell established a telegraph line through New York State, connecting New York and Erie, Mr. Chapin was engaged as operator, and two years later became superintendent of the eastern division of the New York & Erie Telegraph Company. In 1854 he was placed in charge of the police telegraph service in New York, and later became superintendent of the fire alarm telegraph, which position he occupied until 1870. Between 1879 and 1887 Mr. Chapin was superintendent of the American District Telegraph Company in New York, and then went to Philadelphia to take charge of the telegraph and telephone service of the Bureau of Gas, which position he occupied at the time of his death. Mr. Chapin possessed a letter of recommendation from Professor Morse dated 1853, of which he was very proud.

Trade and Industrial Notes.

THE DAVIS & EGAN MACHINE TOOL COMPANY, Cincinnati, O., has just issued a handsome catalogue illustrating and describing its line of bicycle machinery. The catalogue is of standard size, 9 x 12.

THE DIAMOND STATE FIBRE COMPANY, West Canal Street, Elsmere, Del., has recently made large additions to its plant, and keeps constantly on hand a large stock of well-seasoned hard fibre of all thicknesses and colors. The price of this material has been greatly reduced.

BICYCLE ELECTRIC LIGHT.—The Ohio Electric Works, Cleveland, O., report a large business in their bicycle electric lights, necktie electric light and their small Edison motor. They also manufacture medical batteries, battery motors and a full line of electrical novelties. A dealer in electrical goods who fails to get catalogues and prices from the Ohio Electrical Works works against his own interests. They claim not only to excel but to undersell all.

CHAS. A. SCHIEREN & CO., New York, report recent sales of leather belting, as follows: Two 72-inch three-ply leather belts for the Municipal Electric Company, Brooklyn, N. Y.; two 56-inch three-ply leather belts for the Manchester Electric Light Company, Manchester, N. H.; one 44-inch three-ply belt for the Edison Electric Illuminating Company, Pottsville, Pa.; also the complete equipment of the Baltimore Sugar Refining Company for about $6000 worth of leather belting.

THE WALKER COMPANY.—That the Walker Company, Cleveland, O., is meeting with substantial encouragement in the prosecution of its large business is evident from the fact that it has opened a branch works on the Pacific Coast. The new establishment is located at the corner of Fremont and Howard Streets, San Francisco, where the Pacific Coast office of the company is also located. The increased demand for Walker apparatus on the Pacific Coast led to the opening of the branch works at this point.

AN ELECTRICAL EDITION.—The *National Recorder*, Washington, D. C., in its issue of Sept. 5, devotes much space to a description of the latest applications of electricity, including Röntgen ray work, electric lighting and electric railways Quite a large amount of space is given up to an elementary discussion of electricity, its generation and application. The front page of the issue is an elaborate illustration in colors of the most prominent applications of electric power. The work complete possesses considerable merit.

BALL ENGINES.—Orders have been placed with the Westinghouse Electric Company, Pittsburg, and Ball Engine Company, Erie, Pa., by an electric light company at Jalapa, Mexico, for a 350-hp tandem-compound engine direct-connected to a Westinghouse alternating machine. The National Tube Works, McKeesport, Pa., recently ordered from the Ball Engine Company, Erie Pa., through its Pittsburg representatives, F. R. Dravo & Co., a 250-hp engine, direct-connected to a Crocker-Wheeler generator. The plant will be used for power transmission.

THE MURRAY IRON WORKS COMPANY, Burlington, Ia., has completed and put in operation its new shops built for the manufacture of Corliss engines. It will be remembered that this company last Spring bought out the plant of the Sioux City Engine Works and moved its machinery, patterns, drawings, etc., to Burlington. The new shops are now turning out the well-known Sioux City Corliss engines under the supervision of the same engineering force that produced them at Sioux City. As the older Murray shops are completely equipped for the manufacture of boilers and slide-valve engines, the concern is fully prepared to supply the trade with power plants, both large and small. And, despite the hard times, it is now doing the largest business in its 26 years' experience.

THE ST. LOUIS IRON & MACHINE WORKS.—We are informed that the Maryville (Mo.) Electric Light & Power Company will abandon its old steam plant, and that its new plant which has just been completed by the St. Louis Iron & Machine Works is now in operation. The new plant will furnish the entire city with electric lights and is a model one in every way. The boiler capacity is 250 horse power, and a "St. Louis Corliss" engine furnishes power to drive a 40-light T.-H. arc dynamo; a 50-kw General Electric generator, and a 75-kw Fort Wayne alternator. The same company is furnishing a new plant for the Trenton (Mo.) T.-H. Electric Light & Power Company where it will install a 125-hp "St. Louis Corliss" engine with shafting, etc., and also the entire steam plant for the Bement (Ill.) Electric Light & Power Company's new lighting station, consisting of two horizontal steel boilers and a "St. Louis Corliss" engine of 125 horse-power.

THE C & C ELECTRIC COMPANY, New York, has received orders for its well-known type of direct-connected motors to ventilating wheels, for operating Blackman fans, to be used in the following establishments: One 36-inch, New York College; two 48-inch, Teachers' College; two 60-inch, Princeton Library; one 60-inch and two 48-inch, American Lithographic Company; two 60-inch and two 36-inch, New York Athletic Club; one 48-inch, Bank of Commerce; two 60-inch, Columbia College (Physics Building); three 60-inch, Columbia College (School of Natural Science); two 60-inch, Columbia College (Engineering Building); three 84-inch, Columbia College (Chemistry Building); one 60-inch, New York Savings Bank, and two 36-inch, Coe Building. The Blackman fans were furnished by Howard & Morse. Other orders for ventilating work are as follows: One 1 horse-power, one 3 horse-power, one 5 horse-power, three 7½ horse-power, two 15 horse-power for the Hudson River State Hospital, Poughkeepsie, N. Y.; three 5 horse-power, one 12 horse-power, one 18 horse-power for Ward's Island; one 10 horse-power for University of Virginia, Richmond, Va.; one 5 horse-power for Sloane Maternity Hospital, New York.

THE CLONBROCK STEAM BOILER COMPANY, Brooklyn, reports a large rush of business, its order sheet being so full that it is necessary to have on a night force to complete orders already booked for Jan. 1, 1897. Among its latest orders are the following; American Manufacturing Company, Brooklyn, 500 horse-power; Hazelton Electric Light Company, Hazelton, Pa., 800 horse-power; People's Light & Power Company, Jersey City, N. J., 800 horse-power; Municipal Electric Light Company, Brooklyn, N. Y., 2000 horse power, and one steel self-supporting smokestack, 16 inches in diameter and 175 feet high; Economy Light, Heat & Power Company, Scranton, Pa., 1000 horse-power; Johnson Coal Company, Priceburg, Pa., 400 horse-power; Marshall Paper Company, Turners Falls, Mass., 150 horse-power; People's Light & Power Company, Orange, N. J., 200 horse-power; Geo. Watkinson Rubber Works, Philadelphia, Pa., 250 horse-power; Esparanza Plantation, Bayou Lapourche, La., 600 horse-power; Mathieson Alkali Works, Providence, R. I., 300 horse-power; Brush Electric Company, Providence, R. I., 300 horse-power; New York Steam Company, New Station, New York City, 3000 horse-power; Brush Electric Company, Baltimore, Md., 1000 horse-power; Coney Island & Brooklyn Railway Company, Brooklyn, N. Y., 700 horse-power.

Business Notice.

THE ILLUSTRATIONS in this issue were made by the Photo-Engraving Company, 67–71 Park Place, New York.

Illustrated Record of Electrical Patents.

UNITED STATES PATENTS ISSUED SEPT. 15, 1896.
[In charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

567,586. DYNAMO-ELECTRIC MACHINE; G. E. Dorman, Chicago, Ill. App. filed Feb. 4, 1896. A dynamo-electric machine comprising a base or lower portion provided with an upwardly projecting pole-piece, a second pole-piece opposite said first pole-piece, and consisting of two or more independent sections adapted to be independently connected with said lower portion, and an armature mounted between said pole-pieces.

567,599. ELECTRIC CUT-OUT AND ANNUNCIATOR; J. Kipps, New York, N. Y. App. filed Feb. 11, 1896. The combination with a bent metallic standard having a slot, a non-conducting support therefor, a tag pivoted to the standard and constructed with a tongue and an insulated spring provided with a stop and a stud, a wire held under tension by the spring and arranged to release the tongue of the tag from the stop or stops, and the stud of the spring by its elongation when subjected to an electric current.

567,608. AUTOMATIC CUT-OUT; H. F. Parshall, London, England. App. filed July 18, 1896 An automatic cut-out for dynamo-electric machines, comprising a motor device having one of its members in the main lead from the dynamo to the bus-bars and its other member taking current from a distribution system external to the machine to be controlled, and a cut-out in one of the leads of such machine, the motor device and cut-out being mechanically connected.

567,643. STREET ANNUNCIATOR; H. P. Frear, San Francisco, Cal. App. filed Nov. 13, 1895. In a street annunciator, a main containing case, open at the front, therein a revoluble cylinder or drum provided with hinged tablets, the drum indented or provided with a chamber at one end and receiving within its contour the electromagnet actuating apparatus.

567,651. AUTOMATIC REGULATOR FOR ELECTRIC MOTORS; H. P. Merriam, New York, N. Y. App. filed April 28, 1896. The combination of an electric motor, mechanism operated thereby, a variable resistance, a cut-out for the motor and means for operating said cut-out independent of said variable resistance controlled by the condition of pressure or work in said operated mechanism.

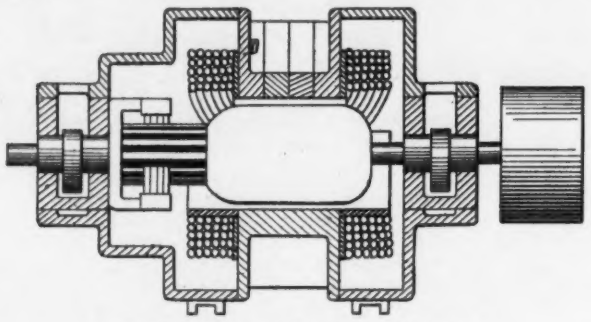
567,688. TELEPHONE; R. F. Rankin, Philadelphia, Pa. App. filed Oct. 22, 1895. The combination of circuit connections leading to a diaphragm electrode and to a support, a rolling electrode carried by said support and adapted to close said circuit and a hinged or pivoted transmitter carrying said support and adapted to be turned to change the inclination thereof and cause the rolling electrode to gravitate in respect to the diaphragm for controlling said circuit.

567,690. TROLLEY CATCHER; O. R. Sackett, Niagara Falls, N. Y. App. filed May 16, 1896. The combination with a trolley pole, of a supporting frame pivoted at its upper end to the trolley pole so as to be capable of reversal thereon, a spring drum journaled in said frame and a rope or cord wound upon said drum.

567,691. ELECTRIC ARC LAMP; P. R. Salberg, Allegheny, Pa. App. filed Jan. 11, 1896. In a regulator for arc lamps, the combination of independent or loosely mounted drums, a series of cog wheels, one of which has a spring connection with one of said drums, a lever mounted or pivoted upon the axis of said drums and carrying a pawl engaging one of said cog wheels, said lever having a spring-suspended armature at its free end carrying an escapement or dog, a magnet for actuating said armature, a lever adapted to engage said escapement or dog carrying a spring-controlled armature and a second magnet for actuating the latter armature in controlling the lower carbon, the upper carbon being controlled from the said drums.

567,714. REGULATING ADMISSION OF CURRENTS TO MOTORS; F. E. Herdman, Winnetka, Ill. App. filed Dec. 21, 1895. In combination with an

electric motor, a source of current supply connection between the source of current supply and the field and armature of motor, a device adapted in its movement in one direction to increase the amount of current in the armature, a centrifugal governor driven by said motor and connection between said device and the governor, the connection being such that the position of the governor limits the movement of said device in one direction and means independent of said governor to move said device in the other direction.



567,586.—Dynamo-Electric Machine.

567,719. DYNAMO-ELECTRIC MACHINE; H. W. Libbey, Boston, Mass. App. filed Sept. 16, 1895 A dynamo-electric machine having a frame adapted to be fastened to a bicycle, an arm depending from said frame, a rotatable shaft mounted in said arm and having a threaded end with a friction wheel thereon, a bevel wheel secured to the other end of said shaft, a vertical shaft with a wheel on its lower end meshing in said bevel wheel, field magnets secured to said frame, a commutator mounted on said shaft, brushes on said frame engaging said commutator, a circular plate secured to the upper end of the shaft, armatures secured thereto, and provided with spools electrically connected with said commutator and a lamp connected with one of said field magnets and a brush of the commutator.

567,721. METHOD OF PRODUCING ELECTRICITY; J. R. Payson, Jr., Chicago, Ill. App. filed Feb. 24, 1896. A galvanic cell having its electrodes surrounded by diverse electrolytic fluids of which the electrolyte surrounds the positive electrode containing sulphurreted hydrogen and a diaphragm separating said fluids.

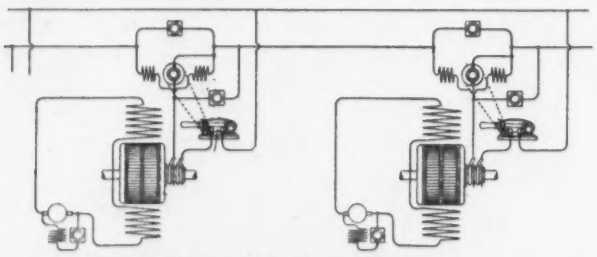
567,745. COMMUTATOR; F. J. Haerer and C. L. Gikeleiter, Philadelphia, Pa. App. filed April 11, 1896. In a commutator, a plurality of half discs having recesses near their periphery, means for holding said discs in assembled position, and filling pieces for recesses.

567,746. ARMATURE FOR DYNAMO-ELECTRIC MACHINES; F. J. Haerer and C L. Gikeleiter, Philadelphia, Pa. App. filed April 11, 1896. An armature having a plurality of coils or windings, heads upon which the same are supported, clamps mounted upon said heads, and adapted to lock said coils in position and means for securing said clamps to said heads.

567,753. RAILWAY-CROSSING SIGNAL; C. Selden, Baltimore, Md. App. filed April 21, 1896. In a crossing signal, the combination with a vibrator having a circuit adapted to be closed at both sides of the crossing, a magnet having a circuit at the crossing, and an armature therefor controlling a shunt around the vibrator-contacts, the lever of the vibrator being adapted to lock said armature in the shunting position.

567,754. TROLLEY CONTACT DEVICE; R. Skeen, Madison, Ill. App. filed Sept. 19, 1895. An improved trolley contact device, comprising a contact-piece extending along horizontally above the trolley-wire and insulated therefrom, but in the path of the trolley, and capable of lateral motion, but none vertically, and adjunctive devices electrically connected to said contact-piece.

567,759. ELECTRIC SIGNAL; C. P. Wilkinson, Jackson, Mich. App. filed Dec. 7, 1895. A circuit maker or breaker comprising circuit terminals, a pivoted lever or levers having at the lower end over the trolley-wire a T-head set at an oblique angle edgewise to the wire, and wheel so that said wheel will have a shearing contact with the head, and means connecting said lever and contact points.



567,608.—Automatic Cut-out.

567,760. ELECTRIC TRACK SIGNAL; C. P. Wilkinson, Jackson, Mich. App. filed Dec. 12, 1895. In a signaling apparatus, the combination of a fulcrumed lever, bearing contact points, and an elbow-lever having one end engaging the end of the fulcrumed lever and the other end provided with a T-head convex in horizontal cross-section.

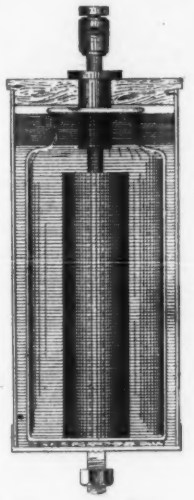
567,784. INSULATED CROSS-OVER FOR TROLLEY WIRES; A. Hanson, Chicago, Ill. App. filed April 3, 1896. In a cross-over for contact-wires of electric railways, the combination with a central casting of an insulating block secured thereto, end pieces mounted upon said insulating-block, means for securing one of the contact wires thereto, lugs formed upon said central casting, said lugs, insulating block and end piece forming a runway upon which the contact wheel may travel, a second runway pivoted to said central casting in such a manner that it may be adjusted at any desired angle, and means for securing the second contact wire to said second runway.

567,816. ELECTRIC CONTACT DEVICE; R. Skeen, Madison, Ill. App. filed Feb. 17, 1896. A trolley contact device comprising an insulated bar to be moved above the trolley-wire, depending contact-plates carried thereby in the path of the trolley, said plates being turned outward at one end and having a secondary contact with said bar, an electrical connection by which the circuit is open or closed according to the direction of travel of the trolley.

567,818. ELECTRICAL CONDENSER; N. Tesla, New York, N. Y. App. filed June 17, 1896. An electrical condenser constructed or provided with means for exclusion of air and gas and an armature composed of a conducting liquid.

567,840. ELECTRIC ARC LAMP; J McLaughlin, Chicago, Ill. App. filed March 4, 1895. In an electric arc lamp, a main magnet, a mechanical resistance device, an armature for said magnet, a pivoted lever acting to establish the counteracting influence of the mechanical resistance device, a shunt magnet, intermediate mechanism between said shunt magnet and the mechanical resistance device and a loose joint between the pivoted lever and the intermediate mechanism whereby the said lever may assume a position relatively remote from the main magnet and brought by said magnet into relatively close proximity thereto before establishing the said counteracting influence of the mechanical resistance device.

567,841. BOND FOR ELECTRIC RAILWAYS; J. McLaughlin, Chicago, Ill. App. filed April 13, 1896. A bond or connector for electric railway rails, consisting of a conductor or conductors, a bushing and self-locking key.



567,818.—Electrical Condenser.

567,845. BURGLAR ALARM; W. H. Ward, Mound City, Kan. App. filed June 23, 1896. In a bank vault, the combination of a spring-supported and downwardly-yielding false floor, with a battery carried thereon, one of the wires from said battery extending upward and normally in contact with a second wire extending through the said vault to a distant plate, an electro-magnet or armature connected to the other end of said wire, suitable ground connections, a centrally-pivoted armature lever having a contact-wire at its base; and a battery in circuit therewith, an electric bell or annunciator; and a retracting spring connected to the upper end of said armature lever whereby when the armature or electromagnet is de-energized by the depression of the false floor and breaking of the contact of the wires within the vault, the said retracting spring will operate the armature lever and force the contact-wire at the base thereof against and in circuit with the said electric bell or annunciator.

567,870. TROLLEY GUARD; F. S. Birth, Philadelphia, Pa. App. filed Nov. 19, 1895. In a trolley guard, a trolley arm, a primary trolley wheel carried thereby, a rock arm pivoted to said trolley arm, two secondary trolley wheels journaled in said rock arm and springs for retaining the rock arm in a normal position.

567,899. CONTACT DEVICE; F. W. N. E. Hayn, Bahia, Brazil. App. filed May 14, 1896. In a contact device, the combination with a contact bar constructed of aluminum, a cross-section whereof is U-shaped and the edges thereof are adapted to engage the current-conductor, and complete the electrical circuit therewith, of material adapted to reduce the friction and wear of the contact parts disposed in said device adjacent to the contact edges of the bar.

567,924. INTERCHANGEABLE ELECTRIC SIGN; W. J. Scott and H. W. Shonnard, New York, N. Y. App. filed May 22, 1896 An interchangeable electric sign comprising a reservoir wheel bearing the different letters, etc., composed of incandescent lamps, a sign board or frame having parallel channels for the letters, means for adjusting the wheel and sign to each other and means for rotating the wheel and delivering the letters to or receiving them from the sign.

567,928. IGNITING DEVICE; H. Van Hoevenbergh, New York; N. Y App. filed July 1, 1896. An igniting device for inflammable substances comprising a plurality of fine conductors supported in contact with one another at a number of points.